Sec 27

SCIENCE

CONGRESS
SERIAL RECORD
APR 14 1952

APRIL 11, 1952

VOLUME 115 NUMBER 2989

Contents

Structure and Properties of Ice: *Niels Bjerrum* 385

News and Notes 390

Association Affairs

Sessions for Contributed Papers at the St. Louis Meeting 395

Gordon Research Conferences, June 16–August 29: *W. George Parks* 395

Laurentian Hormone Conference: *Gregory Pincus* 401

Technical Papers

Effect of Phosphorylated Hesperidin, a Hyaluronidase Inhibitor, on Fertility in the Rat: *Gustav J. Martin* and *J. M. Beiler* 402

Uracil Protection against Ultraviolet Radiation Damage to a Higher Plant: *H. S. Puleston, Jess L. Fults,* and *Merle G. Payne* 402

Metabolic Relationship between *Meso*-Inositol and Lindane: *A. S. Srivastava* 403

Serological Differentiation of Fish Bloods: *John E. Cushing* 404

Comments and Communications

Lobbyist for American Science: *Lyle B. Borst* 405

Geography at Harvard: *Erwin Raisz* 405

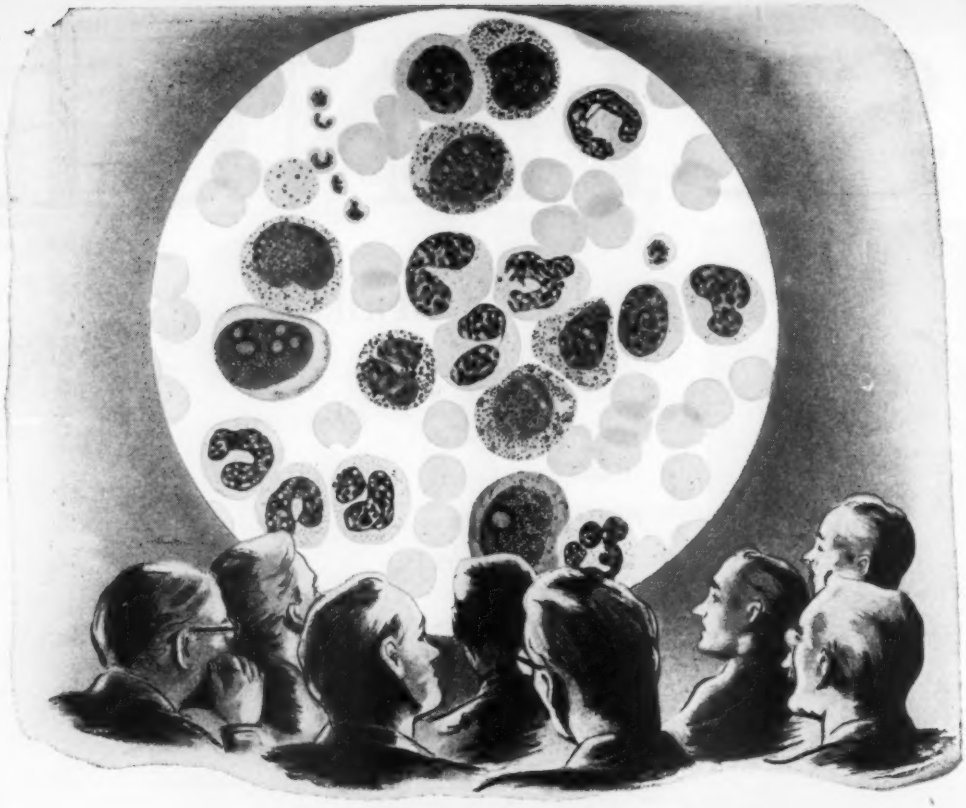
Radiation Sensitivity of Benzene-d_6: *Sheffield Gordon* and *Milton Burton* 406

Scientific Book Register 406

Krilium 3

Meetings & Conferences 18

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



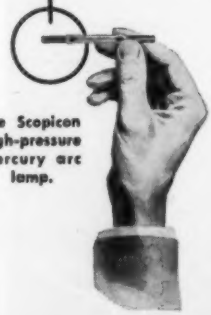
images up to 10 feet across

even under oil-immersed objectives

Because of the virtually solar intensity of the Scopicon's high-pressure mercury arc, you can project sharply detailed images up to ten feet across even under oil-immersed microscope objectives. The light's white color demonstrates the various biological stains to their best advantage.

The Scopicon is highly adaptable — can be used with equal convenience for small-group study in a normally lit room, or for exhibition to large groups in a darkened auditorium. Let us send you the brochure describing this versatile instrument.

The Scopicon light source generates a light intensity of approximately 64,000 lumens. The projected light beam is remarkably steady — neither wanders nor flickers.



The Scopicon high-pressure mercury arc lamp.

Scopicon

micro-projection equipment

SCOPICON, Inc. 215 E. 149th ST. NEW YORK 51, N. Y.

Ready for Fall Classes!

COMPARATIVE VERTEBRATE EMBRYOLOGY

by OLIN E. NELSEN, Ph.D.

University of Pennsylvania

Authoritative, Teacher-Tested Approach

Here is a brilliant contribution to the field of Vertebrate Embryology. The material is based on the successful classroom experience of a well-known teacher and outstanding research scholar. Written at the student level, in an understandable and stimulating style, it provides the basic understanding of the subject so essential for future courses.

Comprehensive Coverage

Both teacher and student will welcome this well-organized, easy-to-follow presentation of a wealth of information. For better comprehension, detailed explanations of the reproductive organs, gametogenesis, the union of germ cells, and fertilization are presented before the discussion of cleavage. The orderly growth of the embryonic body is clearly and concisely described to provide the student with an appreciation of the significance and sequence of developmental processes in comparative anatomy. Abundant use of comparative material is made throughout the book.

Unique Illustrative Material

The 300 original illustrations are unusually effective in presenting the interrelation of growing structures. They have been prepared under the direct supervision of the author from material in his laboratory. The ectoderm, endoderm and mesoderm are sharply and vividly differentiated by the use of a new, illustrative shading technic—permitting an immediate recognition of the derivative structures of each germ layer.

Approximately
800 Pages
380 Illustrations
$6.50

The correlation of laboratory work with subject matter, the pertinent bibliography and the extensive index all add to the extreme teachability of this outstanding new text.

USE THIS HANDY COUPON TO RESERVE YOUR COPY NOW!

The Blakiston Company
1012 Walnut Street
Philadelphia 5, Pa.

THE BLAKISTON COMPANY
1012 Walnut Street, Philadelphia 5, Pa.
105 Bond Street, Toronto 2, Canada

Please send me Nelsen's "Comparative Vertebrate Embryology." If requested for personal use, I understand you will credit my account in full if I return it within 10 days.

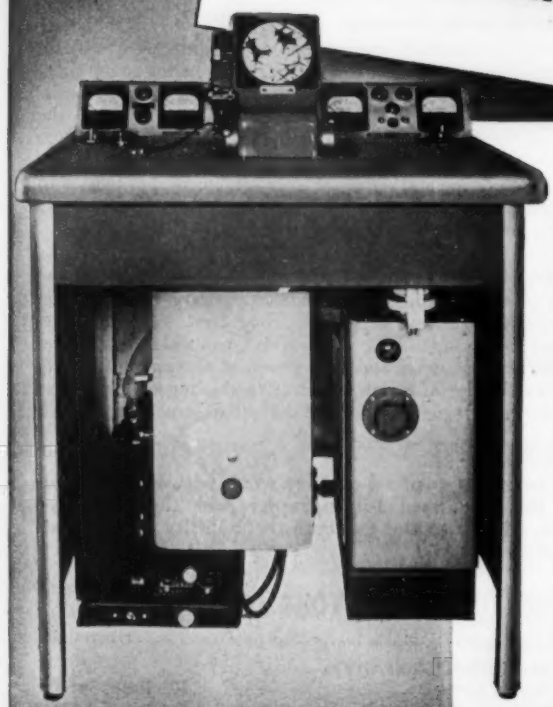
☐ Send for 90-day teacher examination.
☐ Send for personal use.

Name .....
School .....
Address .....
City ..... Zone ..... State .....

Sc. 4-11-52

Announcing

FARRAND
ELECTROSTATIC
ELECTRON MICROSCOPE



FEATURES

Resolving power 30 au — freedom from astigmatism — ease of alignment — distortionless image at all magnifications — consistent high image quality at direct magnifications up to 20,000X.

The image of the specimen does not rotate with changes of magnification; this is of particular importance in stereo studies. The electrical center in electrostatic lenses coincides with the geometrical center, therefore, alignment is simplified.

Electron gun is of high intensity and efficiency — filaments are easily and quickly replaceable — adjustment for pinhole position and beam alignment can be made during instrument operation — specimen holder permits manipulation in three translational motions.

Power supply is small, compact and easy to service — output voltage is variable making operation possible over a wide range without change of focus.

Large area viewing screen — built-in camera arrangement without air lock — specimen holder permits rapid change and setting of specimen.

Adaptable for electron diffraction techniques — stereo electron micrographs.

Bulletin 807 Sent Upon Request

FARRAND OPTICAL CO., Inc.

Engineers, Designers and Manufacturers

PRECISION OPTICS, ELECTRONIC AND SCIENTIFIC INSTRUMENTS

BRONX BLVD. & E. 238th ST., NEW YORK 70, N. Y.

Gladys M. Keener
Executive Editor

AAAS EDITORIAL BOARD
(Terms expire June 30, 1952)

Howard A. Meyerhoff, **Chairman**
William R. Amberson Karl Lark-Horovitz
Bentley Glass Lorin J. Mullins
Walter J. Nickerson
F. A. Moulton, Advertising Representative

Krilium

THE new soil conditioner Krilium has received a great deal of publicity since a preliminary announcement was made at the Philadelphia meeting of the AAAS last December. It is a soil conditioner and not a fertilizer. No claims are made for fertilizer value of the material, but the improvement of physical conditions resulting from its use may cause the plant nutrients of soils, as well as those of fertilizers, to become more useful to growing plants.

Krilium is a pale-yellow powder that can transform tight, gummy clays into friable materials of crumb-like structure. Even though it must dissolve in the soil moisture to promote physical improvement, Krilium does not move or leach below the zone of application; hence its effectiveness in the plow-depth may be somewhat limited by impervious subsoil conditions.

Chemically this material is a sodium salt of a hydrolyzed polyacrylonitrile. It is a long-chain, organic molecule, somewhat similar in structure to the nylon molecule and it is nontoxic at the rates of application used. It improves soil structure by aggregating and loosely cementing clay particles together in much the same way that decomposing organic matter acts. Yet the new compound decomposes in the soil very slowly, at a rate not yet determined.

Krilium is one of a family of chemicals developed by the Monsanto Chemical Company at Dayton, Ohio. It is not yet available commercially but is expected to be on the market some time in 1953. The Department of Agriculture and several state agricultural experiment stations have been interested in the agricultural possibilities of this material since it was first brought to their attention. During the 1951 growing season, preliminary experiments were conducted by the USDA on saline and alkali soils in California, to find out if Krilium or closely related compounds might aid in their reclamation or in the production of more nearly normal crop yields. Favorable results were obtained, with remarkable increases in germination and stands of corn. In one case, yield increase was as much as fivefold. Other experiments at our field stations in Alabama, Tennessee, Pennsylvania, and Wisconsin are not yet fully evaluated, but the material has been shown to produce definite improvement in the physical character of heavy clay soils. Better aeration, which is necessary for normal root development, is one of the beneficial effects.

Best results are obtained when Krilium is applied to a soil previously prepared for seeding. The dry powder should be spread uniformly, and mixed immediately and thoroughly to the desired depth. Rates of application range from 400 to 2000 pounds per acre when incorporated in soil to a six-inch depth. Unfortunately, the possibilities of widespread agricultural use do not seem large at present in view of proposed high introductory prices.

There are, however, a number of specialized agricultural uses for which the material should be practical—for example, preparation of potting soils, greenhouse production of flowers and vegetables, home flower and vegetable gardens located on heavy soil, and possibly certain market garden areas where high-value specialty crops are grown. For garden plots Krilium should be mixed thoroughly to spade depth, using a rate of about 0.1 per cent, or 1 pound to 20 square feet. In the case of potting soil, 1 ounce should suffice for 100–150 pounds of soil. Another field of utilization includes the stabilization of soil in road cuts and similar engineering projects, where an application of 1 pound per 100 square feet applied on the surface serves to hold the soil while turf is being established from seed. Additional research is planned by this Bureau and by state agricultural experiment stations. One of the items receiving attention in this Bureau is the treatment of a narrow band of soil above or around the seed or a shallow over-all treatment for the purpose of improving emergence.

R. Q. PARKS

Bureau of Plant Industry, Soils, and Agricultural Engineering
U. S. Department of Agriculture

SCIENCE, founded in 1880, is published each Friday by the American Association for the Advancement of Science at the Business Press, 10 McGovern Ave., Lancaster, Pa. Entered as second-class matter at the Post Office at Lancaster, Pa., January 13, 1948, under the Act of March 3, 1879. Acceptance for mailing at the special rate postage provided for in the Act of February 28, 1925, embodied in Paragraph (d-2) Section 34.40 P. L. & R. of 1948.

All correspondence should be sent to SCIENCE, 1515 Massachusetts Ave., N.W., Washington 5, D. C. The AAAS assumes no responsibility for the safety of manuscripts or for the opinions expressed by contributors. Four weeks' notice is required for change of address, and an address stencil label from a recent issue must be furnished. Claims for a missing number will be allowed only if received within 60 days from date of issue.

Annual subscriptions, $7.50; single copies, $.25; foreign postage, outside the Pan-American Union, $1.00; Canadian postage, $.50. Special rates to members of the AAAS.

The AAAS also publishes THE SCIENTIFIC MONTHLY. Subscription and advertising rates on request.

Cable address: ADVANCESCI.

Now available . . .

Adenosine Triphosphate (ATP); Amygdalin; Amylase; Animal Lecithin; Ascorbic Acid Oxidase; Bacitracin; BAL; Biotin, cryst.; Caffeic Acid; Carotene, cryst.; Catalase; Cellulase; Chlorogenic Acid; Chorionic Gonadotropin; Circulatory Hormone; Colchicine; Cytidylic Acid; Cytochrome C; Dehydroascorbic Acid; Diacetonamine; Dihydroxyacetone; Dihydroxyphenylalanine (DOPA); Dipyridyl; Edestin; Emulsin; Erythritol; N-Ethylpiperidine; Fibroin; Folic Acid; Galacturonic Acid; Gentisic Acid; Girard Reagents P and T; Gliadin; Glucose Pentaacetate; Glucuronic Acid; Glyceraldehyde; Glyceric Acid; Heparin; Hordenine; Hyaluronidase; Hydrindene; 2-Hydroxyadipaldehyde; Humulon; Indan; Isoascorbic Acid; Isopropylarterenol; Kojic Acid; Kynurenic Acid; Lanthionine; Lipase; Lysozyme; Lyxose; Malononitrile; Maltase; Melezitose; Mesobilirubinogen; Muscle Adenylic Acid; Myanesin; p-Nitrophenylphosphate; Nucleoprotein; Orcinol; Pancreatin; Pantothenyl Alcohol; Penicillinase; Peroxidase; Phenazine; Phenylpyruvic Acid; Phloridzin; Phosphorylase; Piperin; Porphyrindine; Protamines; Protoporphyrin; Pyridoxal; Pyridoxamine; Pyrocatechuic Acid; Pyruvic Aldehyde; Ribonuclease; Saccharic Acid; Salmine; Serine Phosphoric Acid; Spermidine; Spermine; Thioacetic Acid; Thiocytosine; Thyroxine; Trigonelline; Triphenyltetrazolium Chloride; Tripyridyl; Trypsinogen; Tyrosinase; Tyrothricin; Urease; Uricase; Uridine; Vitellin; Xanthosine.

Ask us for others!

DELTA CHEMICAL WORKS

23 West 60th St. New York 23, N.Y.

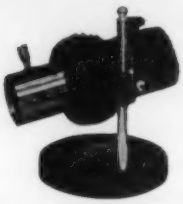
Telephone PLaza 7-6317

NEW MIKRARK ILLUMINATOR

Using Zirconium Arc Lamp

for
MICRO-PROJECTION

for
PHOTO-MICROGRAPHY



Mikrark Illuminators provide an intense, cool point source of light through the use of the new 100 watt Zirconium bulb. This steady light source is ideal for microscopy and photo-micrography. It is the correct color temperature for full color pictures. *MODEL C-100 with improved cooling system illustrated.*

Write for further details or demonstration to

J. BEEBER CO., INC.

838 Broadway, N.Y.C. AL. 4-3510
1109 Walnut Street, Philadelphia

For Spectrochemistry

MACHLETT ***has the answer***

Coleman "6-A" Junior Spectrophotometer

- **PRECISE—Continuous wavelength selection coupled with high photometric accuracy yields maximum precision with ONE dial setting.**
- **SIMPLE—Automatic constant band-pass . . . no need to calculate and readjust slit width with each change of wavelength.**
- **RELIABLE—No mechanical complexities such as amplifiers or vacuum tubes which change with time.**

THIS RUGGED spectrophotometer is another example of the fine line of scientific products carried by MACHLETT. Because of its speed, simplicity and convenience of operation, the Coleman "6-A" is especially suited for the expeditious analytical laboratory. Fingertip control and direct reading, interchangeable scales enable rapid testing of a variety of metals, foodstuffs, vitamins and a myriad of industrial materials.

For more details on the Coleman "6-A", Write for Bulletin B-211 today.

76-855A Coleman 6-A with battery and connecting cable . . . $455—

Visit our Exhibit in Booth 35 at the Meeting of the Federation of American Societies for Experimental Biology being held at the Hotel Statler, New York City, Apr. 14–17.

MACHLETT

E. MACHLETT & SON

ESTABLISHED 1907

Laboratory APPARATUS • SUPPLIES • CHEMICALS

220 EAST 23rd STREET • NEW YORK 10, N.Y.

NEW Beseler
TEACHING AID

Mailed
FREE
to you
on request

OPAQUE PROJECTION
Practices
SERVICE BULLETIN FOR CLASSROOM TEACHERS by CLASSROOM TEACHERS
The ABC's of the Opaque Projector
A New Film on the Opaque Projector
Where to Find Additional Information on the Opaque Projector
Share Your Knowledge • Share Your Knowledge • Share Your Knowledge

OPAQUE PROJECTION PRACTICES is a free service bulletin; a literary clearing-house of visual teaching practices in all grades and for all subjects. It discusses many applications of opaque projection to improving student interest and understanding. It is a medium of exchange, between classroom teachers, relating to specific usages of the opaque projector at all teaching levels. It is a continuing study of current information on the growing place and use of the opaque projector in modern visual education. Its frequent listing of free source material alone is invaluable to teachers with limited budgets.

Fill out and mail the coupon below, and we shall gladly send you with our compliments the current issue of OPAQUE PROJECTION PRACTICES, and mail you regularly forthcoming issues.

CHARLES Beseler COMPANY
EST. 1868
60 Badger Avenue, Newark 8, N. J.
The World's Largest Manufacturer of Opaque Projection Equipment

Editor, O.P.P., c/o Charles Beseler Co.,
60 Badger Ave., Newark 8, N. J.

Please send me without charge the current issue of OPAQUE PROJECTION PRACTICES and put me on your mailing list to receive forthcoming issues.

NAME _____

SCHOOL _____ TEACHING GRADE _____
(Home or School)

ADDRESS _____

CITY _____ ZONE _____ STATE _____

GBI

Reg. U. S. Pat. Off.

SPECIAL RESEARCH BIOCHEMICALS

Allantoin
Alloxan
Arterenol (nor-adrenaline)
Bilirubin
Blood Fibrin
L-Borneol
Cadaverine
Calcium Phytate
Cephalin
Cholesterol U.S.P.
2,4 Dichloroanisole
2,4 Dinitrophenol (M.P. 112–113° C.)
Epichlorohydrin
Fibroin (Silk)
Flavianic Acid (2,4, Dinitro-1-Naphthol-7-Sulfonic Acid)
Fumaric Acid 90% (Pract.)
Glutaric Acid
Glutathione (Reduced)
Glutathione Sodium Salt (Reduced)
Glutathione (Oxidized)
Glycogen
Histamine (Free Base)
Histamine C.P. Dihydrochloride
Histamine Diphosphate, U.S.P.
Indole-3-Acetic Acid
Indole Butyric Acid
Indole-3-Propionic Acid
Inosinic Acid (barium salt)
Inositol Hexaphosphoric Acid

See Science April 25 issue for additional listings

A READY REFERENCE
That will Save Time for You

Use this catalog as a "one stop" source of Amino Acids, Vitamins, Carbohydrates, Adenylates, Nucleates, Purines, Pyrimidines, Tetrazolium Salts, Enzymes, Microbiological and Bacteriological Media, Complete Animal Test Diets and Ingredients for investigational use.

WRITE FOR YOUR COPY TODAY

GENERAL BIOCHEMICALS, INC.
60 LABORATORY PARK • CHAGRIN FALLS, OHIO

"THE MACHINE TO COUNT ON"

ORIGINAL-ODHNER

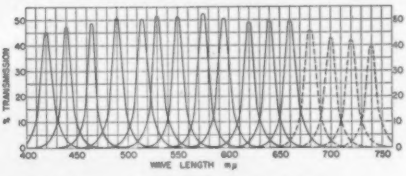
Your personal
laboratory calculator

For quick calculating in the laboratory this compact, light-weight portable calculator is unsurpassed. Performs all needed calculating operations, from the simplest to the most complicated, with remarkable time-saving ease. Weighs only 12 pounds —the utmost in precision design and construction—rapidly becomes your all-round inseparable lab companion. Priced low.

Send for bulletin EO-43

Ivan Sorvall, inc.
210 FIFTH AVENUE, NEW YORK 10, N. Y.

G.A.B. Interference Filters
(Made in Switzerland)
for isolating narrow spectral bands



Spectral Range: 400-900 millimicrons
Spectral Width: 12-15 mμ, Transm.: 45-50%
Sizes: 2" × 2", 2" × 1", 1" × 1", others on order.

For
Microscopy
Flame Photometry
Colorimetry and Densitometry
and for all other problems requiring monochromatic light in the visible and near-infrared.

Write for details to

PHOTOVOLT CORP.
95 Madison Ave. New York 16, N. Y.

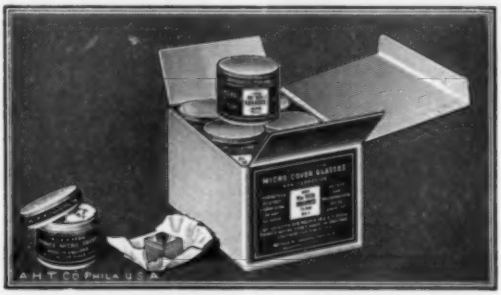
Also: Dichroic and neutral beam splitters, phase plates
First-surface mirrors, low-reflecting coatings
Heat-reflecting filters, electrical coatings

NON-CORROSIVE, RED LABEL

MICRO COVER GLASSES

Flat, free from brittleness, and of the highest resistance to attack by moisture

NOW AVAILABLE FOR IMMEDIATE SHIPMENT



Showing ¼ oz. round wooden boxes and carton containing twelve ¼ oz. boxes (6 ounces)

MICRO COVER GLASSES, Non-Corrosive, Red Label, A.H.T. Co. Specification. Cut, selected and packed in Philadelphia from Chance micro sheet made in England continuously since 1840—see, "Thin Glass for Microscope Cover-Slips," *Nature (London), Vol. 147, No. 3739 (June 28, 1941), p. 803*—and of the same excellent quality as sold and recommended by us since 1902.

This glass is of the highest resistance to attack by moisture, slightly greenish in color, remarkably free from brittleness, and very flat.

The relative absence of a certain degree of brittleness found in many other resistance glasses is the unique physical characteristic of Chance micro sheet. This property greatly reduces breakage in handling and cleaning, particularly of large rectangles, and has been repeatedly emphasized by scientists with many years experience as a reason for their preference for this cover glass.

	Per ounce	*Per oz. in 6 oz. carton	Per oz. in 48 oz. assortments	Per oz. in 72 oz. assortments
SQUARES, No. 1, 18 mm, 22 mm and 25 mm	2.34	2.11	1.98	1.87
No. 2, 18 mm, 22 mm and 25 mm	1.82	1.64	1.55	1.46
CIRCLES, No. 1, 18 mm, 22 mm and 25 mm	3.38	3.04	2.87	2.70
No. 2, 18 mm, 22 mm and 25 mm	2.82	2.54	2.40	2.26
RECTANGLES, No. 1, 22×30 up to and including 24×40 mm. Packed in ½ oz. pasteboard box	2.34	2.11	1.99	1.87
Ditto, No. 2	1.82	1.64	1.55	1.46
LARGE RECTANGLES, No. 1, i.e. 24×50 mm up to and including 48×60 mm	2.72	2.45	2.31	2.18
Ditto, No. 2	2.06	1.85	1.75	1.65

* One size, shape and thickness only.

ARTHUR H. THOMAS COMPANY

LABORATORY APPARATUS AND REAGENTS

WEST WASHINGTON SQUARE

PHILADELPHIA 5, PA.

Teletype Services: Western Union WUX and Bell System PH-72

technicon

announces a

new mounting medium for coverglass adhesion with

higher refractive index

Overcomes disadvantages of the various synthetic resins, as well as Canada Balsam, Gum Damar, etc.

- Spreads smoothly
- Won't crack, darken or acidify
- Hardens quickly
- Won't cause fading
- Won't crystallize
- Won't influence pH
- Higher melting point
- Refractive Index 1.650

Send for *free* sample on your letterhead to—

The Technicon Chemical Co.
Dept. M, 215 East 149th St., New York 51, N. Y.

BACTO CONCENTRATION DISKS

Bacto-Concentration Disks are for determination of penicillin level in milk, serum, urine and other body fluids.

The concentration disks contain measured amounts of penicillin.

The following standardized materials are recommended for this procedure:

Bacto-Pencillin Disks
Bacto-Penase Disks
Bacto-Subtilis Spore Suspension
Bacto-Whey Agar

DIFCO LABORATORIES
Detroit 1, Michigan

Complete details of this procedure available upon request.

C.P. PURITY

ASPARAGINE

MONOHYDRATE

FOR IMMEDIATE DELIVERY

IN

10-100-1000 grams and **LARGER QUANTITIES**

100 GRAMS	L	DL	D
	$6.00	$7.50	$40.00

H. M. CHEMICAL CO., LTD

1651—18th St. **SANTA MONICA, CALIF.**

WHATEVER THE LABORATORY NEEDS

Laboratories have at their command from Fisher Scientific Company all of their day-to-day requirements plus a large number of modern instruments, apparatus and chemical reagents not obtainable elsewhere. (At their command, too, are Fisher's Analytical Methods Division and Fisher's facilities for instrument service and repair.)

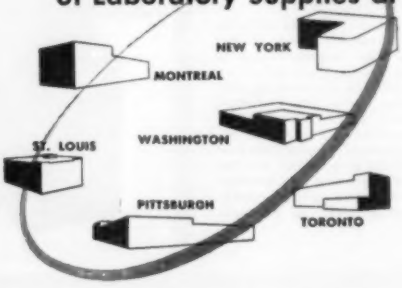
INSTRUMENTS

REAGENTS

APPARATUS

FURNITURE

Comprehensive Stocks
of Laboratory Supplies at



FISHER
SCIENTIFIC CO.

PITTSBURGH (19) • NEW YORK (14) • SILVER SPRING, MD. • ST. LOUIS (18) • MONTREAL • TORONTO

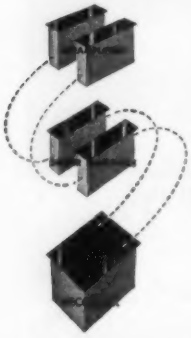
REAL RECORDING VERSATILITY

Your choice of 1-, 2-, or 4- channel systems — each with all the advantages that the famous name "Sanborn Viso" denotes

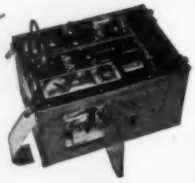
VISO-CARDIETTE

While designed primarily as a direct-writing clinical electrocardiograph that can quickly record *all* accepted leads, this oldest member of the "Viso family" will also register *many other* phenomena, using suitable supplementary equipment. Its proven recording principles provide the basis for the design of the 1-, 2-, and 4-channel systems below. These instruments feature standard "Viso" advantages: immediately visible, permanent records traced by heated stylus (no ink) on plastic coated, continuous chart paper; recording in *true* rectangular coordinates; *independent* timing; and simplified control. The recording paper speed of Viso-Cardiette is 25 mm/sec. Paper width is 6 cm with a 5 cm recording area.

INTERCHANGEABILITY of Preamplifiers and Amplifiers permits recording of many different types of phenomena.



Any of the recording channels in the three systems at the right may include *either* a Strain Gage or General Purpose Amplifier, or the latter in combination (in 2-, and 4-channel systems) with either AC or DC Preamplifiers. For, any of the Amplifiers or Preamplifiers provided for in a system may be quickly *removed* from its place in the system and as quickly *replaced* with an alternate type.



VISO RECORDER (SINGLE CHANNEL)

A simple and *lower cost* means of securing all the recording advantages of the Viso-Cardiette (described above), when electrocardiography is not a requirement, is offered in this assembly. The system comprises a single-channel recording unit, patterned closely after that of the Viso-Cardiette, and assembled in one case with *either* a General Purpose or Strain Gage Amplifier which are *interchangeable* as described at the left.

TWIN-VISO CARDIETTE (TWO-CHANNEL)

The two channels of the Twin-Viso operate independently of each other, but register simultaneously on one Permapaper record. Or, one channel may be used alone, with 1-channel recording Permapaper. A standard, "built-in" feature of the Twin-Viso is a choice of *ten* paper speeds which may be selected at will by the operator thru a quick and simple interchanging of sets of gears. These speeds are in pairs of 5 and 0.5, 10 and 1, 25 and 2.5, 50 and 5, and 100 and 10 mm/sec. Either speed of any pair selectable at will by panel control. Standard "Viso" recording advantages (described above) are inherent in the Twin-Viso and the Poly-Viso Cardiettes, and to them is added manually or remotely controlled code marking.

POLY-VISO CARDIETTE (FOUR-CHANNEL)

This multi-channel research recorder provides for one-, two-, three-, or four-channel registrations on one record, using Permapaper of appropriate widths. The Poly-Viso operates under the same principles as the Viso- and Twin-Viso Cardiettes described above and offers a "built-in" choice of eight paper speeds: 50, 25, 10, 5, 2.5, 1.0, 0.5, and 0.25 mm/sec., *all* selectable by panel control.

RECORDERS AND AMPLIFIERS ARE AVAILABLE SEPARATELY

The Recorders, Amplifiers and Preamplifiers of which the above complete systems are comprised may be obtained *separately*, to be combined or integrated by the user with other equipment.

For descriptive literature or information of any kind about this equipment, address

SANBORN CO.

CAMBRIDGE 39 MASSACHUSETTS

NEW! LAB-CHRON

ELECTRIC STOPWATCH
OFFERS 11 EXCLUSIVE FEATURES

1. Unconditionally guaranteed for 1 year.
2. Built-in brake gives instantaneous stop. Absolutely eliminates all slide.
3. Zero finding reset is built into special counter—not added to standard counter.
4. Optimum visibility angle due to case design.
5. High torque synchronous motor specially designed for timing.
6. No oiling—lifetime sealed lubrication.
7. Fully protected start and stop switch has bakelite finger case button.
8. One finger reset gives easier, faster resetting.
9. Panel mounting model available.
10. Small and compact—no external knobs.
11. 3-wire grounded cord and plug available on request.

Available in 1/10 sec. model reading to 9999.9 secs. and 1/100 min. model reading to 999.99 mins. Case—aluminum. Finish—grey Hammerloid.

No. 94650 Seconds Model (for 110 V., A.C.)
No. 94651 Minutes Model (for 110 V., A.C.)

$49.50

NEW! MAGNE-STIR

The *ONLY Magnetic Stirrer With* TEFLON COVERED STIRRING MAGNETS

The most compact, most powerful, small magnetic stirrer ever developed. Ideal for stirring in closed systems, in a vacuum, in open systems or under pressure. Ideal for mixing in awkward vessels such as tiny flasks, or will agitate solutions in a group of test tubes simultaneously. The MAGNE-STIR incorporates many new and unusual features and its eye-appealing appearance and rugged dependability are due to good engineering and careful workmanship.

NOTE THESE MANY EXCLUSIVE FEATURES

★ Rugged, strong *cast* aluminum case.

★ Teflon coated magnetic stirring bars, will not break when dropped. Resistant to all acids and alkalis.

★ More powerful motor; will stir up to 1 liter of liquids with viscosities up to 60% glycerol solution.

★ Standard support rod 7/16" diameter is screwed into heavy aluminum base and can be used to support apparatus on the stirrer base or can be fastened to set-up frame support rod with standard clamp holder.

★ Positive, complete speed variation from barely turning to vigorous churning action.

★ Separate on-off switch permits stirrer to be turned on and off without disturbing speed setting.

9320 MAGNETIC STIRRER, Alumaloy, Magne-Stir.

"MAGNE-STIR." Supplied with 6 ft. line cord and plug, support rod, 1 Teflon covered stirring bar 5/16 in. by 1 1/4 ins. and 1 Teflon covered stirring bar 5/16 in. by 1 3/4 ins. but without clamps or glassware. For use on 115 volts 50-60 cycle A.C. Each **$32.50**

ALNICO STIRRING BARS for use with

"MAGNE-STIR" or other types of magnetic stirrers. Alnico-Stirring Bars may be assorted to obtain maximum discount.

Cat. No.	Type	Size	Each	Dozen
9320/1	Teflon Covered	3/4" x 5/16"	2.50	2.25
9320/2	Teflon Covered	1-1/4" x 5/16"	2.75	2.47
9320/3	Teflon Covered	1-3/4" x 5/16"	3.00	2.70
9320/4	Pyrex Glass Covered	3/8" x 3/8"	1.85	1.75
9320/5	Pyrex Glass Covered	3/8" x 7/8"	1.85	1.75
9320/6	Pyrex Glass Covered	3/8" x 1-1/2"	1.85	1.75

STANDARD SCIENTIFIC SUPPLY CORP.
34 West 4th Street New York 12, N. Y.

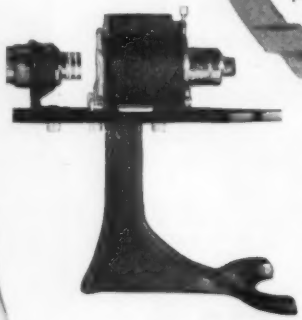
MORE *Teaching Advantages*

FOR YOUR BUDGET DOLLAR

Having trouble fitting essential equipment into your budget? Here are three basic instruments that will fill just about every classroom need—and you can amortize their low cost over years of daily, practical use.

B&L MODEL LRM BALOPTICON PROJECTOR

Most versatile projector for class use. Large, brilliant, detailed images of slides *and* of opaque objects, printed matter, scientific specimens. Catalog E-11.



B&L TRIPLE-PURPOSE MICRO-PROJECTOR

Projects permanently mounted specimens, images for tracing or drawing, and live specimens in liquid. Catalog E-20.

B&L "FL" MICROSCOPE

Full standard size! Pre-focusing gage saves class time. Many more teaching advantages not obtainable with any other student microscope, at any price. Catalog D-185.

WRITE

for free demonstrations and budget consultation with a B&L sales engineer. Bausch & Lomb Optical Co., 642-23 St. Paul St., Rochester 2, N. Y.

B&L Bausch & Lomb *Educational* Instruments

Structure and Properties of Ice[1]

Niels Bjerrum
Copenhagen, Denmark

WATER is not only one of the most common and most important chemical compounds, but it is also one of the most anomalous and intriguing. Its problems have been treated in innumerable papers. To reach a full understanding of its behavior, we must first elucidate the properties of ice. This problem is easier because the structure of ice is simpler and better known than that of water. I have tried to deduce the properties of ice from a simple electrostatic model of the H_2O molecule, and I shall review the results obtained.

A tetrahedral model of the H_2O molecule. We know from Mecke (*1*) that the three nuclei of an H_2O molecule form an isosceles triangle with the oxygen nucleus at the apex and the two protons on the base line. The sides are (in water vapor) 0.97 A, and the apical angle 106°; hence, they are nearly equal to the tetrahedral angle 109.5°. In ice the sides are *ca* 0.99 A (*2*), and we shall assume that the apical angle is exactly the tetrahedral one (Fig. 1, *a*). The three positive nuclei are encircled by ten electrons. Two of them circle quite close to the oxygen nucleus, and the eight remaining electrons circle in pairs in four eccentric orbits, which radiate tetrahedrally from the oxygen nucleus, and of which two include the two protons (Fig. 1, *b*). The electron orbits completely screen the positive charge of the oxygen nucleus. They also screen a considerable part of the charge of the protons but give an excess of negative charge in the direction of the two orbits that do not contain protons. As model of an ice molecule we shall therefore use a regular tetrahedron of radius 0.99 A, with positive charges on the two corners and negative charges on the other two (Fig. 1, *c* and *d*). In order to give the tetrahedral model the known dipole moment of the H_2O molecule (1.87 Debye), the electrical charges on the corners must be $\pm 0.171\ e$ (e = the electronic charge). In ice these tetrahedra are placed at a mutual distance of 2.76 A. We shall therefore imagine an ice molecule as a sphere of diameter 2.76 A, inside which four electric charges are placed in a regular tetrahedral arrangement.

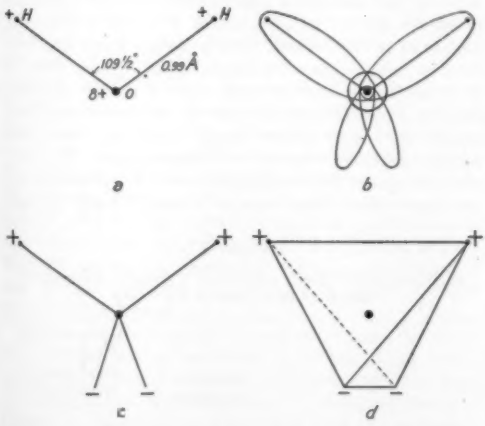


FIG. 1. Electrostatic model of an H_2O molecule: *a*, the position of the positively charged nuclei; *b*, the electron orbits, schematically indicated; *c* and *d*, two different presentations of the tetrahedral model of the H_2O molecule.

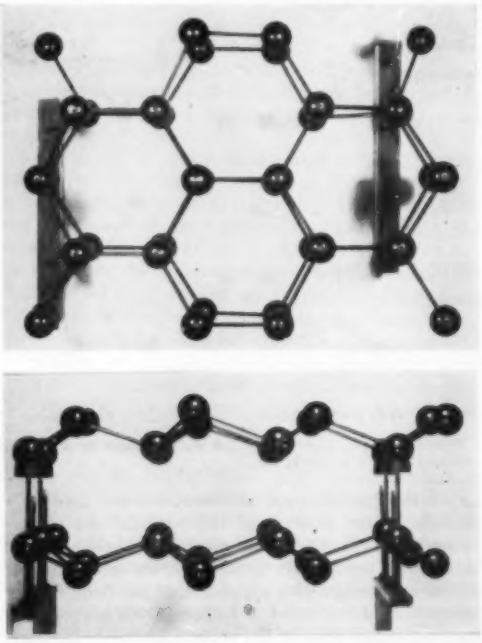


FIG. 2. Model of an ice crystal, reproduced from W. H. Bragg, *Proc. Roy. Inst. Gt. Brit.*, **30**, 283 (1938).

The crystal structure of ice. In an ice crystal the molecules—or more exactly, the oxygen atoms—lie in puckered hexagonal layers, in which the oxygen atoms are raised and lowered alternately (Fig. 2). Adjacent layers are mirror images, and the sizes of the parameters are such that each atom is surrounded by four oxygen atoms in regular tetrahedral arrangement at a distance of 2.76 A (Barnes [*3*]). The regular tetrahedral arrangement is a consequence of the tetra-

[1] Based on a paper published in *Kgl. Danske Videnskab. Selskab, Math.-fys. Medd.*, **27**, (1), (1951).

hedral structure of the H_2O molecule. Each positive corner of a molecule is attached by electrostatic forces to a negative corner of another molecule and forms with it what is often called a hydrogen bond.

A substance in which every atom has four neighbors in regular tetrahedral arrangement can crystallize hexagonally (as ice) or cubically (as diamond). Let us try to find out why ice crystallizes hexagonally and not cubically. The difference between the two structures lies in the arrangement of the six neighbors around a pair of adjacent atoms. In the cubic diamond crystal, the position is always *center-symmetric* (Fig. 3), whereas in the hexagonal ice a quarter of the positions are *mirror-symmetric*, and only the other three quarters of the positions are center-symmetric. It does not seem possible to build a crystal in which more than a quarter of the positions are mirror-symmetric. This suggests that the bond energy between H_2O molecules is higher in the mirror-symmetric position than in the center-symmetric position. The suggestion is supported by some old and accurate x-ray measurements on ice by H. D. Megaw (*4*). From these measurements I have calculated that the mirror-symmetric bonds in ice are *ca* 0.5 per cent shorter than the center-symmetric ones, a not insignificant difference, considering the low compressibility of ice. This suggestion is even more directly supported by the following calculation: Using for the H_2O molecule the electrical model described above, the electrostatic lattice energy can be calculated, for a hypothetical cubic ice crystal with all bonds center-symmetric, to 14.51 kcal/gmol, and for the ordinary hexagonal ice crystal, with a quarter of the bonds mirror-symmetric, to 14.93 kcal/gmol—i.e., 0.42 kcal/gmol higher. The calculated values are valid at low temperatures. For reasons that are given below, the values decrease somewhat with increasing temperature and approach each other slightly at the melting point.

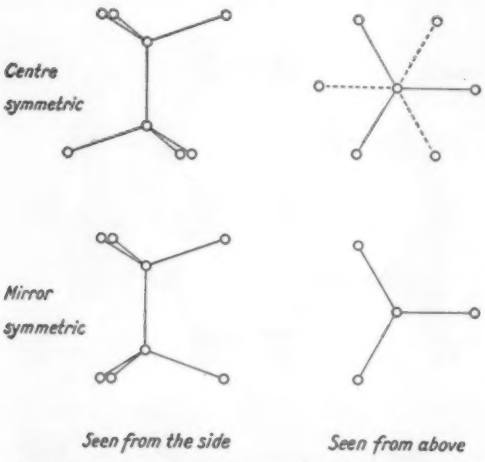


FIG. 3. The two positions of the six neighbors to a pair of adjacent oxygen atoms in ice.

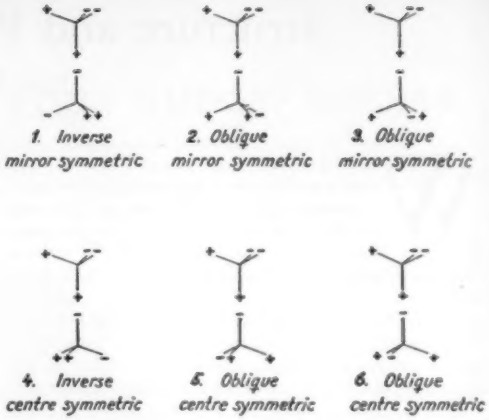


FIG. 4. The six positions of two neighbor molecules in ice.

The configurations of an ice crystal. As yet we have only considered the arrangement of the *oxygen* atoms in ice. The arrangement of the *protons* is a much more complicated question. We have good reason to believe the H_2O molecules are arranged in such a way that the protons always lie on the lines connecting adjacent oxygen atoms, and that there is one, and only one, proton on each of these lines, forming with the two oxygen atoms what is often called a hydrogen bond. There exists a very large number of configurations fulfilling these conditions. The reason is that both the center-symmetric and the mirror-symmetric bonds can be either inverse or oblique (Fig. 4). Pauling (*5*) has calculated this number of configurations of an ice crystal to 1.5^N, where N is the number of molecules in the crystal. This is a very large number, even in comparison with astronomical figures. For 18 g of ice it is a number with more than 10^{23} figures. Pauling is of the opinion that all configurations have nearly the same lattice energy and are therefore equally probable even at low temperatures. If, however, we accept the tetrahedral model described above, the electrostatic bond energy is considerably higher

TABLE 1

ELECTROSTATIC BOND ENERGIES BETWEEN ADJACENT MOLECULES IN ICE IN 10^{-12} ERG

	Without correction	Corrected for second neighbors' attractions	
		Low temp	High temp
Inverse mirror-symmetric	0.5067	0.5196	0.5395
Oblique " "	.4319	.4781	.4713
Oblique center-symmetric	.4792	.5143	.5143
Inverse " "	0.4117	0.4532	0.4547

for the inverse mirror-symmetric positions than for the corresponding two oblique mirror-symmetric positions, and the energy for the two oblique center-symmetric positions is higher than for the corresponding inverse center-symmetric positions (Table 1).

The number of the two bond types with high bond energies must increase with decreasing temperature at the cost of the two other types. This makes a correction for the electrostatic energies between every other molecule very complicated. In Table 1 corrected values are given corresponding to low temperature, where only the bonds with high bond energy are present, and to high temperature, where all the bonds present are in the statistically expected amount. By means of a Boltzmann equation approximate values are calculated for the ratio between inverse and oblique positions at several temperatures (Table 2).

TABLE 2

APPROXIMATE PERCENTAGES OF INVERSE AND OBLIQUE POSITIONS IN ICE

	273° K	136.5° K	90° K	68.25° K	Statistical percentage
Inverse mirror-symmetric	68.4	90.4	97.7	99.44	33.3
Oblique mirror-symmetric	31.6	9.6	2.3	0.56	66.7
Oblique center-symmetric	90.9	98.0	99.62	99.92	66.7
Inverse center-symmetric	9.1	2.0	0.38	0.08	33.3

Application of the Boltzmann equation is not fully justified, and calculated values therefore must be used with caution. Even at the melting point the percentages are far from being the statistical ones, corresponding to equal energies.

Heat of sublimation. By means of the figures in Table 2, the electrostatic lattice energy of an ice crystal can be calculated. Since the ratio between inverse and oblique positions changes with temperature, the lattice energy will be dependent on temperature. At low temperatures, when only inverse mirror-symmetric and oblique center-symmetric positions are present, a value of 14.93 kcal/gmol is found; and at high temperatures, when the ratio between inverse and oblique positions is as 1 to 2, a value of 14.32 kcal/gmol is found.

The electrostatic lattice energy constitutes the main part of the heat of sublimation of ice (12.14 kcal/gmol). In order to calculate more accurately the heat of sublimation, it is necessary to subtract the potential of the repulsive forces that hold the molecules in place at a distance of 2.76 A and to add the potential of the van der Waals' forces. By means of a triangular model for the H_2O molecule, Bernal and Fowler (*6*) have calculated a heat of sublimation of the right order of magnitude. Using their estimated corrections for the repulsive forces (−6.8) and for the van der Waals' attraction (+4.1), we calculate for the heat of sublimation:

$$\text{At low temperature } 14.93 - 6.8 + 4.1 = 12.23$$
$$\text{At high temperature } 14.32 - 6.8 + 4.1 = 11.62$$

which is in good agreement with the observed value of the heat of sublimation 12.14 at 0° C and corrected to 0° K 11.81.

Zero-point entropy. From the behavior of ice in an alternating electric field we know that, at the melting point, the configuration of the ice changes rapidly, but that, at the temperature of liquid air (*ca* 90° K), the configuration freezes in. At this temperature, according to Table 2, about 99 per cent of the positions are the most stable ones. This explains why the heat capacity irregularities in the temperature range where the configuration freezes in, as found by Giauque (*7*), are small. The irregularities are so small that they seem to indicate that at 90° K only 0.1 per cent of the positions with small bond energies are present.

Pauling (*5*) is of the opinion that all the 1.5^N configurations of an ice crystal are equally probable even at the temperature where the configuration freezes in, and by means of this assumption he calculates the zero-point entropy of ice to $R \ln 1.5 = 0.806$ kcal/gmol/degree, in good agreement with the observed value 0.82 ± 0.15. If the configurations are not all equally probable at the temperature where they freeze in, then the observed zero-point entropy should be smaller than Pauling's value. The figures in Table 2 for 90° K suggest a value of only a few hundredths of Pauling's value; consequently it seems necessary to find another explanation of the observed zero-point entropy.

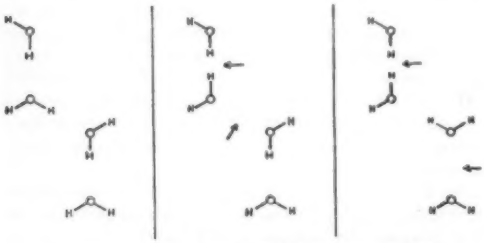
Changes in configuration and molecular turns. Debye (*8*) has explained the high dielectric constant of ice (*ca* 80) by the existence in ice of electric dipoles, which frequently turn from one position of equilibrium to another under the influence of the thermal movements. From the behavior of ice in an alternating field, Dorsey (*9*) has calculated the rate of dipole turns per molecule to 0.83×10^6 sec^{-1} at 0° C, and from the temperature coefficients of dielectric properties the activation energy (the critical threshold energy) has been calculated to be from 9.3 to 14.6 kcal/gmol by a series of different authors. A value of 13 seems to be most probable.

It is difficult to explain the molecular nature of the frequent dipole turns in ice. The H_2O molecule is, of course, a strong dipole, and every molecule in the crystal lattice of ice can have its dipole axis in six different directions, all perpendicular or antiparallel to each other; but in an ideal ice crystal a single molecule (apart from the few surface molecules) cannot turn to another position of equilibrium. Only by simultaneous turning of all the molecules in a closed ring or in a row of molecules, beginning and ending in the surface, is it possible to change the configuration to a new equilibrium position. Such turnings, however, must be very improbable and, what is more

important, by turning of all the molecules of a ring, the dipole moment of the crystal will not be changed, and these turnings therefore cannot be used for the Debye theory.

In every ice crystal, however, lattice faults occur, and at the fault sites it is to be expected that single molecules can easily turn to new positions and thus change the direction of their dipole axes. We must here direct our attention to such lattice faults as are caused by thermal movements, which occur in a concentration, determined by the temperature. There are two types of such faults: *orientation fault sites,* where two neighboring molecules are incorrectly orientated toward each other with two protons or with no protons on the line between their oxygen atoms; and *ionization fault sites,* where H_3O^+ or HO^- ions occur in the lattice instead of H_2O molecules.

Orientation fault sites. If, on account of strong thermal movements, an ice molecule has rotated at such a large angle that two protons happen to be placed between two oxygen atoms and no proton between two other oxygen atoms (Fig. 5 *b*), the chance



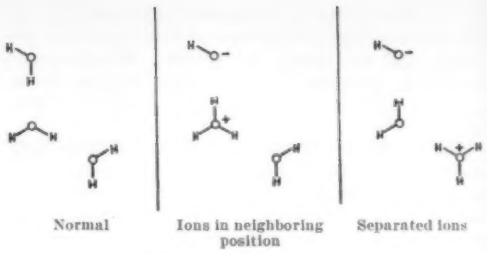
a, Normal | *b,* Orientation faults in adjacent linkages | *c,* Orientation faults separated

FIG. 5. Formation of orientation fault sites.

that it will turn back is great, but it may happen that one of the adjacent molecules has turned before it turns back. In that case the site with two protons and that with no proton have been separated (Fig. 5 *c*). Continued molecular turns may cause the appearance of two independent fault sites of opposite types: sites with two protons, and sites with no proton between two oxygen atoms. These fault sites will migrate around in the crystal until they meet a fault site of the opposite type with which they can recombine. Under the influence of formation and recombination of the fault sites an equilibrium must be reached with well-defined and equal concentrations of the two types.

Two molecules between which there is an orientation fault site can easily turn to a new position, and every time one of the two molecules turns, the fault site is moved to a new position and the dipole moment of the molecule is rotated through 90°. The fault sites thus act as a kind of catalyst for the promotion of dipole turns.

If the previously described tetrahedral model is used, the formation of an orientation fault site can be estimated to require an energy $E_1 = 11.9 \pm 1.7$ kcal/gmol, and the activation energy for turns of molecules at a fault site can be estimated to be $E_2 = 2.5$ kcal/gmol. The energy of activation, corresponding to the temperature coefficient of the rate of molecular turns at orientation fault sites, is $E_1 + E_2 = 14.4 \pm 1.7$. The activation energy for the dipole turns which bring about the dielectric properties of ice was stated above to be *ca* 13. This shows that it is permissible to consider the molecular turns, occurring at the orientation fault sites as the dipole turns, as required by Debye's theory.



Normal | Ions in neighboring position | Separated ions

FIG. 6. Formation of ions.

It is not possible to calculate exactly the concentrations of the orientation fault sites in ice; but from certain reasonable assumptions I have estimated the concentration of each type to be one fault site for every 10^6 ice molecules, corresponding to a rate of molecular turns at an orientation fault site of *ca* 10^{12} sec^{-1}.

Ionization of ice. Ice has an electrolytic conductivity of a magnitude similar to that of water. Johnstone (*10*) gives the following values for the static (direct-current) conductivity of ice (κ):

Temp	0°	−1°	−4°	−10°	−19°
$\kappa \cdot 10^9$	(0.4)	(2.8)	0.23	0.11	0.026

The value at −1° is probably too high, on account of the impurities in the ice. The value given for 0° is extrapolated from the values at −4°, −10°, and −19°.

The conductivity of ice must be due to H_3O^+ and HO^- ions and their migration by means of proton jumps. It is improbable that these ions as units can migrate through the crystal lattice at rates that are of significance in this connection, or that other ions can do it. The H_3O^+ and HO^- ions are formed by proton jumps between two adjacent molecules: $H_2O + H_2O \rightarrow HO^- + H_3O^+$; and they are separated by means of proton jumps between the ions and H_2O molecules: $H_3O^+ + H_2O \rightarrow H_2O + H_3O^+$ and $HO^- + H_2O \rightarrow H_2O + HO^-$ (Fig. 6). The ions migrate in the ice by means of proton jumps until oppositely charged ions meet and have the opportunity of recombining.

The proton jump conductivities (μ) of H_3O^+ and HO^- ions in *water,* calculated as the surplus conductivities of these ions, compared with normal ions, are 200 and 105 at 0° C. The proton jump conductivities of these ions in *ice* must be assumed to be somewhat higher. In ice adjacent molecules are nearly always

in the right position (hydrogen bond position) for proton jumps, but in water this is not the case. Correcting for this difference, I have estimated the molecular conductivities of the ions in ice to be 215 and 83 at 0°. From these conductivities and from the specific conductivity of ice, it follows that at 0° C 0.27×10^{-9} parts of the molecules are transformed to H_3O^+ ions and an equal amount to HO^- ions (in water 0.63×10^{-9} parts).

The failure of proton jumps in ice to explain the high dielectric constant. The rate of proton jumps in ice can be estimated from its conductivity. This can be done by means of an old formula of Einstein's (*11*), which connects the diffusion coefficient of a particle (the conductivity of an ion) with the mean displacement of the particle (the ion) in a given time. The rate is found to be 152 sec^{-1}/H_2O molecule at 0° C. This rate is *ca* 10^4 times less than the rate of molecular turns at orientation fault sites.

Proton jumps in ice are connected with dipole turns in a way similar to that in which migrations of orientation fault sites are. It has been proposed by several workers (*12–14*) that the dipole turns necessary for Debye's theory of the dielectric properties of ice may be the result of proton jumps and may be connected with the formation or the migration of H_3O^+ and HO^- ions. I myself have independently worked with the same idea. This idea, however, must be abandoned. The molecular turns produced by formation or migration of the ions are far too infrequent for this purposes (152 against 10^6), and, what is even more decisive, the molecular turns connected with the migration of the ions under the influence of an electric force produce a dipole moment in the direction opposite to that of the electric force and thus in the opposite direction to that required by Debye's theory. This can be seen in the following way:

The dipole moment produced by migration of the ions in an isolated block of ice is the vector sum of all the dipole moments, corresponding to the proton jumps connected with the ionic migration, each of which is 0.78 A. This dipole moment (P_1) can also be calculated as the sum of two dipole moments: the dipole moment P_2, produced by the ionic displacements, and the dipole moment P_3, produced by the molecular turns connected with the migration of the ions:

$$P_1 = P_2 + P_3. \tag{1}$$

The dipole moment P_2 is the vector sum of all the dipole moments produced by the individual ionic displacements. Each of these ionic displacements is parallel to a corresponding proton jump, but 2.76/0.78 larger. We must therefore have:

$$P_2 = P_1 \times 2.76/0.78. \tag{2}$$

From (1) and (2) follows:

$$P_3 = -P_1 \times 1.98/0.78.$$

It means that the dipole moment due to all the molecular turns connected with the migration of the ions is in the opposite direction of that corresponding to the proton jumps and numerically 1.98/0.78 times larger. Hence the molecular turns at the ions cannot explain the dielectric properties of ice. It is only the molecular turns at orientation fault sites which are responsible for these properties.

The proton jump conductivity of H_3O^+ and HO^- ions. The transport of electricity, corresponding to the movement of the H_3O^+ and HO^- ions in an electric field, is counteracted by the turns of dipole molecules connected with the movements of the ions. The transport would have been seriously hampered if the dipole moment produced by these turns were not incessantly cancelled by the molecular turns at orientation fault sites with a relaxation time of *ca* 10^{-6} sec (at 0°). To justify considering the conductivity of ice as a simple result of proton jumps, as is done in this paper, it is of decisive importance that molecular turns at orientation fault sites are *ca* 10^4 times as frequent as molecular turns at the ions.

In water the rate of molecular turns per ion must be similar to that in ice (*ca* 10^{12} sec^{-1} at 0°), and the rate of molecular turns per H_2O molecule, as calculated from the dielectric properties, is also *ca* 10^{12} sec^{-1}. Thus, even in the neighborhood of the migrating ion, the dipole moment produced by the migrating ion very quickly disappears. The old, but often criticized, explanation of the abnormally high conductivity of the H_3O^+ and HO^- ions in water, as due to migration of these ions by proton jumps, is thus fully justified.

The plasticity of ice. Ice is a plastic substance. This was first observed in the study of glaciers. The plasticity is due to the ease with which ice crystals glide along a plane perpendicular to the optical axis—that is, along the puckered hexagonal layers of which the crystal is built (Fig. 1). When a bar of ice, cut with its optical axis parallel to its length, is supported horizontally on two blocks, and when the portion between the blocks is loaded uniformly by means of a stirrup with a weight, then the portion directly under the load is slowly (in the course of hours) forced downward without creating optical discontinuities or changes in the optical properties of the ice (*15*). As the number of bonds between the puckered hexagonal layers is small, and as the bonds are all perpendicular to the layer, it is comprehensible that it is along this plane that the gliding takes place.

If all the molecules on one side of the gliding plane had positive (proton-containing) corners toward the plane, and all the molecules on the other side negative (proton-free) corners toward it, then the gliding could be easily understood. The molecules, however, turn at random positive and negative corners toward the gliding plane. If that were not the case, the ice crystal would be an extremely strong dipole. The gliding, therefore, must be combined with turns of the molecules. Consequently it is to be expected that the rate of gliding is connected with the rate of molecular turns in ice. This explains why the gliding rate decreases rapidly as temperature is lowered.

To produce gliding, a certain shearing force per cm^2 gliding area is necessary. This force seems to be about 5 kg/cm^2. When the force is increased above this minimum value, it is to be expected that the gliding rate in the beginning will increase strongly with the shearing force; but long before the rate approaches a critical value of 5×10^{-2} cm/sec, it is to be expected that the rate of gliding will increase only slowly with the force. At the critical rate the gliding distance, in the time a molecule makes a turn (10^{-6} sec), is equal to the distance between the molecules in the gliding plane (4.5 A). The existing observations seem to be in agreement with this conclusion, but they are not sufficiently accurate to verify it.

References

1. MECKE, R., *et al. Z. Physik*, **81**, 313, 445, 465 (1932).
2. CROSS, P. C., BURNHAM, J., and LEIGHTON, P. A. *J. Am. Chem. Soc.*, **59**, 1134 (1937).
3. BRAGG, W. H. *Proc. Phys. Soc. (London)*, **34**, 98 (1922); BARNES, W. H., *Proc. Roy. Soc. (London)*, A, **125**, 670 (1929).
4. MEGAW, H. D. *Nature*, **134**, 900 (1934).
5. PAULING, L. *J. Am. Chem. Soc.*, **57**, 2680 (1935).
6. BERNAL, J. D., and FOWLER, R. H. *J. Chem. Phys.*, **1**, 515 (1933).
7. GIAUQUE, W. F., and STOUT, J. W. *J. Am. Chem. Soc.*, **58**, 1144 (1936).
8. DEBYE, P. *Polare Molekeln*. Leipzig: F. Hirzel, 118 (1929).
9. DORSEY, N. E. *Properties of Ordinary Water Substance*. New York: Reinhold (1940).
10. JOHNSTONE, I. H. L. *Proc. Trans. Nova Scotian Inst. Sci.*, **13**, 126 (1912).
11. EINSTEIN, A. *Ann. Physik*, **17**, 549 (1905); **19**, 371 (1906).
12. HUGGINS, M. L. *J. Phys. Chem.*, **40**, 723 (1936).
13. LATIMER, W. M. *Chem. Revs.*, **44**, 59 (1949).
14. KAUZMANN, W. *Rev. Modern Phys.*, **14**, 40 (1942).
15. DORSEY, N. E. *Op. cit.*, 429.

News and Notes

Scientists in the News

Wm. A. Amberson, of the University of Maryland, will spend the months of August, September, and October as a guest professor in physiology on the medical faculty of the University of Vienna, lecturing on neuromuscular physiology.

Charles W. J. Armstrong, formerly head of the Chemotherapy Section, Laboratory of Hygiene, Department of National Health and Welfare, Ottawa, Canada, has been made director of the Division of Pharmacology, E. R. Squibb & Sons.

Harold W. Brown, director of the School of Public Health of Columbia University, has been appointed dean of the University of Puerto Rico College of Medicine, succeeding **Donald S. Martin,** who resigned. Dr. Brown was Chancellor Benitez' official adviser in planning the establishment of the medical college two years ago. An expert on tropical diseases, he had previously been a professor of parasitology at Columbia.

George F. Carrier, of Brown University, has been appointed Gordon McKay professor of mechanical engineering at Harvard. His work will be mainly in applied mechanics.

Recent visitors at the National Bureau of Standards included **John Cockroft,** director of the British Atomic Energy Research Establishment at Harwell; **Minoru Imoto,** of Osaka City University, Japan; and **E. C. Stathis,** professor of chemistry at the University of Athens. Dr. Stathis has been in the U. S. since last September, when he attended the Chemical Conclave in New York. He spent some time at the University of Minnesota with I. M. Kolthoff and has visited MIT and Harvard. He expected to leave at the end of March for England.

Robert Cruickshank, professor of bacteriology in the University of London at St. Mary's Hospital Medical School, is visiting 16 American and Canadian medical centers, among them the Communicable Disease Center, USPHS, at Alanta, and the laboratories at Chamblee. Dr. Cruickshank was guest of honor at a dinner sponsored by the CDC Branch of the Scientific Research Society of America at Emory University.

The California Texas Oil Company, Ltd., has announced the election of **George M. Cunningham** as president and **J. P. McCulloch** as vice president, of American Overseas Petroleum, Ltd., affiliate of Caltex engaged in exploration.

Richard A. Deno, chairman of the Department of Biological Sciences at Rutgers University College of Pharmacy, will join the faculty of the University of Michigan this fall as professor of pharmacognosy. He will teach two new courses in academic pharmacy.

Chauncey D. Leake, of the University of Texas Medical Branch, Galveston, has been given leave of absence to work on old Egyptian medical papyri at the Institute for Advanced Study. He is giving a series of talks at Eastern institutions on this subject this month and will speak at the Army Medical Library, Washington, Apr. 15, on "Leonardo da Vinci: Scientist and Artist."

Daniel Ludwig, professor of physiology at New York University, has resigned his post to accept appointment as professor of physiology at Fordham University.

Joy B. Phillips, of Morristown, N. J., has been appointed an instructor in zoology at Drew University and will join the college of liberal arts faculty in September. She has been a teaching fellow at Wash-

ington Square College of New York University since 1947.

Melville J. Ruggles, formerly with the Department of State, has been appointed director of the East European Fund. Mr. Ruggles has devoted much of his government service to the study of Russian affairs and was assigned to the U. S. Embassy in Moscow from 1946 to 1948. The East European Fund has been established by the Ford Foundation as a nonprofit organization to assist recent exiles from the USSR of all nationalities.

LeRoy Scharon, associate professor of geology at Washington University, has been elected chairman of the Mining, Geology, and Geophysics Division of the American Institute of Mining and Metallurgical Engineers and becomes a director ex officio of the institute during his year of service.

Raymond J. Seeger, formerly chief of the Aeroballistics Research Department of Ordnance Laboratory at White Oak, Md., has been appointed to the staff of the Division of Mathematical, Physical and Engineering Sciences of the National Science Foundation. Dr. Seeger is secretary of Section L, AAAS.

An advisory panel has been named to assist the Congressional Atomic Energy Committee in connection with atomic plant expansion. **Lewis L. Strauss,** former Atomic Energy Commission member, will head the panel. Mr. Strauss is president of the Institute for Advanced Studies at Princeton.

Sidney Weinhouse, of the Lankenau Hospital Research Institute, will be visiting professor of biochemistry for the first summer session, June 23–Aug. 1, in the School of Medicine, University of California at Berkeley. Dr. Weinhouse will give a course on selected topics on intermediate metabolism.

Walter J. Williams, deputy general manager of the AEC, will assume, in addition to his present post, the duties of assistant general manager for manufacturing, vacated Feb. 29 by the resignation of **Thomas F. Farrell. James L. Kelehan,** formerly assistant director of production, will be assistant to Mr. Williams in both his functions.

Education

Ansel Adams, widely known for his photographs of Yellowstone National Park, will conduct a photo workshop July 7–19 and July 21–Aug. 2 in San Francisco. An intensive course in practical and creative photography will be offered. For particulars, write Registrar, 5 Associates, 131 24th Ave., San Francisco 21.

The **Gulf Coast Research Laboratory,** Ocean Springs, Miss., will open June 10. Research under the direction of A. E. Hopkins, and eight courses of instruction in marine science under the direction of R. L. Caylor, will be offered.

Hebrew Institute of Technology, Haifa, will send a worthy graduate student to the U. S. this summer for two years of study in agricultural engineering at the State College of Washington. The project is jointly sponsored by the Export Division of the Aluminum Company of America, the Institute, The Technion, and Palestine Endowment Funds, Inc., of New York.

Theophile A. Alajouanine, of Saltpetriere Hospital, Paris, has been appointed visiting professor of neurology at the **University of Illinois** College of Medicine for three months beginning Apr. 1; Hiram T. Langston, who will head the Department of Surgery at the new Chicago State Tuberculosis Sanitarium, has been appointed clinical associate professor of surgery, on a nonsalaried basis; and Mary L. Hemmy, of Washington University, has been appointed head of the new Department of Social work. The Medical School is part of the 305-acre Medical Center on Chicago's near west side, where nine new projects are currently under construction.

Lehigh University has received funds from the American Metal Company for the endowment of a scholarship in honor of Harvey M. Burkey, former chief metallurgist of the company. The first award will be made in September.

The sixth session of the **McGill Geography Summer School** will be held at Stanstead College, Stanstead, P. Q., June 25–Aug. 2. Special emphasis will be laid upon the Arctic, the Soviet Union, the Far East, and Canada. The staff will include L. Dudley Stamp, S. H. Beaver, and S. W. Woolridge (England); S. McCune (Colgate University); and the following Canadians: P. D. Baird, F. K. Hare, W. F. Summers, J. L. Robinson, and B. Zaborski.

The new **Neurophysiological Institute,** in Copenhagen, will be dedicated Apr. 16. E. D. Adrian, Master of Trinity College and president of the Royal Society, will give the dedication address. The new institute is sponsored by the Michaelsen, Carlsberg, and Rockefeller foundations, and the Danish government. The Zoophysiological Laboratory, a special section to be devoted to the use of isotopes, will be directed by Professor Ussing.

An **Oregon Teacher Education Survey,** sponsored by the State Board of Higher Education, will be directed by Earl W. Anderson, president of the NEA higher education department and a member of the education faculty of Ohio State University. Dr. Anderson will spend six months in Oregon.

People's University, Upsala, has arranged a course for English-speaking persons Aug. 1–20. *May 10* is the deadline for applications, which should be addressed to "Aspects of Sweden," Upsala. At the **Jacobsberg People's College,** 30 minutes by train from Stockholm, a course dealing with social and economic development in Sweden will be given Aug. 25–Sept. 9. Applications should reach the Swedish In-

stitute, Kunsgatan 42, Stockholm, by *June 1*. The International Graduate School of the **University of Stockholm** offers a special one-year course, beginning in September, for English-speaking students, in political science, economics, and sociology. Applications should be sent to The American-Scandinavian Foundation, 127 E. 73rd St., New York 21.

Stanford University School of Medicine will offer in its illustrated Popular Medical Lectures "The Age of Medical Miracles" (Anthony J. J. Rourke, Apr. 23); and "Natural Childbirth—What It Is and What It Isn't" (Lyman M. Stowe, May 7).

The **University of Texas** Visual Instruction Bureau is collecting a special film library on petroleum subjects in which oil and oil supply concerns may deposit films for use throughout the industry without charge except a nominal service fee. Individuals and companies having films to add, or those needing films for specific purposes, should communicate with Ernest Tiemann, Division of Extension, Austin 12.

The **University of Washington** has appointed C. N. Yang, of the Institute for Advanced Study, a special lecturer in the Department of Physics. Beginning Apr. 21, he will give a two-month series of lectures on problems in statistical mechanics. Robert Serber, of Columbia, will lecture on meson theory June 23–July 23.

Grants and Fellowships

The **Arthritis and Rheumatism Foundation** has awarded 14 fellowships, totaling $64,500, to physicians and biochemists in this country and in England for a year's investigation beginning July 1. The only woman in the group, Madeline K. Keech, of the Canadian Red Cross Memorial Hospital, Maidenhead, Eng., will come to Yale to do her research.

The **Board on Overseas Training and Research** of the Ford Foundation will award up to 100 fellowships to American men and women (under 35) who wish to continue training or research pertaining to Asia, or the Near and Middle East. Awards will be for periods of one to three years, and the work may be done in the U. S. or abroad. For further details and application forms (returnable before *May 15*), address the board at Room 534, 575 Madison Ave., New York 22.

Hahnemann Medical College and Hospital of Philadelphia is offering $1000 fellowships in anatomy, bacteriology, biological chemistry, pathology, pharmacology, and physiology, in support of study leading to the M.S. degree. Application forms may be obtained from the chairman, Graduate Committee.

The **John and Mary R. Markle Foundation** has named 21 medical school faculty members as the fifth group of Scholars in Medical Science. All grants are made direct to the schools at the rate of $6000 annually for five years, for support of specific scholars selected from candidates nominated by the schools themselves.

The **Old Dominion Foundation** has given $5,000,000 to Yale University to aid the liberal arts study program and to restore Connecticut Hall, a national and university landmark; and the **Commonwealth Fund** will finance special studies in human biology and ecology by a grant of $200,000.

The **University of Wisconsin** science writing research assistantship, carrying an allowance of $1,150 for the academic year, is open to applicants who have a degree in journalism or some scientific field. The University of Wisconsin News Service will answer inquiries.

In the Laboratories

New appointments in the **Armour Research Foundation** of Illinois Institute of Technology include Arthur A. Anderson, Jr., chemist, and John J. Hickerson, development engineer, to the Chemistry and Chemical Engineering Research Department, and Arnold Miller as research physical chemist. Louis E. Marchie, inorganic chemist in the Ceramics and Minerals Research Department, has been made senior chemist.

Atul Products, Ltd., the first dyestuffs and pharmaceutical plant in India, was opened with special ceremonies on Mar. 18 in Bulsar. Built with technical aid from the American Cyanamid Co., which has a 10 per cent financial interest in it but no share in the management, the $3,500,000 plant will have a capacity of 4 million pounds of azo and sulfur dyes yearly. Aureomycin and sulfa drugs will also be produced. (*Atul* is from the Hindu word meaning "incomparable.")

Chemstrand Corporation has appointed the following technicians to the research staff at its new Acrilan project in Decatur, Ga.: S. Jack Davis, of Callaway Mills; Frank B. Lutz, of Millville Manufacturing Company; and Charles H. Apperson, of Tennessee Coal and Iron Company.

The following persons from abroad recently visited the USDA **Eastern Regional Research Laboratory**, Philadelphia: L. I. Pugsley, Ontario Department of National Health and Welfare; C. H. Lea, Low Temperature Laboratory, Cambridge, Eng.; A. B. G. Grever, United Can Makers, Ltd., Nijmegan, The Netherlands; J. van der Vliet, Philips-Roxane, Ltd., Bussum, The Netherlands; P. J. van der Laan, Royal Yeast Factory and Distillery, The Hague; D. A. A. Mossel and M. van Eekelen, Central Institute for Nutrition Research, Utrecht.

Daniel J. Cavanaugh and Arthur E. Heath, radiochemists, have been added to the staff of the Chemistry Department, **Nuclear Instrument & Chemical Corporation**, to work on Nuclear's biosynthesized carbon 14-labeled sugars and algae program. Expanded radioisotope applications have recently compelled the company to enlarge its plant by 20 per cent.

Louis Koenig, industrial research chemist, of Stanford Research Institute, Norman C. Penfold, super-

visor of automotive and engine fuels and lubricants research, and Trevor Clark, director of the Division of Military Research and Delevopment, have been named associate directors of **Southwest Research Institute.** Eight specialists in physics, geophysics, and electronics have been added to the staff, and in a further expansion of its general program the institute has adopted a professional development program, of which C. A. Culver, authority on acoustics, will be dean. To encourage study by personnel in their chosen research fields, half the tuition charges for college work will be paid by the institute and its affiliates, The Southwest Foundation for Research and Education (formerly the Foundation for Applied Research) and the Institute of Inventive Research.

Meetings and Elections

The **American Academy of General Practice,** meeting in Atlantic City in March, installed Rufus B. Robins, of Camden, Ark., as president and named Ulrich R. Bryner, of Salt Lake City, president-elect.

At its meetings in Buffalo and Milwaukee the **American Chemical Society** awarded diplomas certifying 50 years' loyal support of the society and its activities to 53 chemists and chemical engineers. Irving Langmuir headed the largest group (New York—nine members). Among others honored were William C. Geer, P. W. Tompkins, Otto S. Marckworth, Edward Mallinckrodt, Jr., Alexander Silverman, Hobart H. Willard, George R. Carr, Richard Fischer, and Lee F. Hawley. Canada was represented by John F. Snell, of McGill University.

The **Centre National de la Recherche Scientifique,** Paris, will be the locale this spring of three symposia, organized with the help of the Rockefeller Foundation, in which U. S. scientists will participate: The Fondements et Applications de la Theorie du Risque en Econometrie, May 12–17, to which Milton Friedman, Jacob Marschak, and Paul A. Samuelson have been invited; Evolution Chez les Plantes, May 15-20, to which Theodor Just and W. M. Heisey have been invited; and Quelques Aspects Modernes des Phenomenes Electrolytiques Intervention du Solvant dans l'Electrolyse, May 23–27, to which Benton B. Owen has been invited. A CNRS Symposium on Leonardo da Vinci, to be held in Paris July 4–7, will be attended by the following from the U. S.: George Sarton (as president of the Union Internationale d'Histoire des Sciences), Henry O. Guerlac, Giorgio de Santillana, and Arthur K. Watson.

The second **International Congress of Biochemistry** will be held in Paris July 21–27. Among U. S. participants in the seven symposia will be S. Granick, M. S. Shorb, E. L. R. Stokstad, H. Borsook, J. S. Fruton, F. Haurowitz, D. Rittenberg, E. S. G. Barron, D. E. Green, F. Lipmann, S. Ochoa, C. H. Li, V. du Vigneaud, E. Chargaff, B. D. Davis, I. C. Gunsalus, E. E. Snell, J. Dufrenoy, W. W. Umbreit, S. A. Waksman, and G. Pincus. For further information, address J. E. Courtois, Faculte de Pharmacie, 4, Ave. de l'Observatoire, Paris (VI^e).

At a meeting in Rome, the **International Mathematical Union** elected Marshall H. Stone as its first president. Dr. Stone is Andrew MacLeish distinguished service professor and head of the Department of Mathematics at the University of Chicago.

British Commonwealth News

W. C. Allen, who has been on the staff of the Commonwealth Solar Observatory at Canberra since 1927, has been appointed to the newly created Perren chair of astronomy at University College, University of London. In his new position Dr. Allen will be actively associated with the Observatory at Mill Hill.

The **Association of Special Libraries and Information Bureaux** (Aslib) will establish a consultant service in the special library and information field with funds granted by the Department of Scientific and Industrial Research.

The 29th meeting of the **Australian and New Zealand Association for the Advancement of Science** will take place in Sydney, N. S. W., Aug. 20–27, under the presidency of Kerr Grant. Chairman of the New South Wales Organizing Committee is K. W. Street, lieutenant governor and chief justice of New South Wales. The University of Sydney will play an important part in the meetings, and A. P. Elkin, of the Anthropology Department, will function as deputy chairman; J. M. Vincent, of the School of Agriculture, as local honorary secretary; and K. O. Campbell, also of the School of Agriculture, as local honorary treasurer.

K. N. Bahl, who resigned the chair of zoology at the University of Lucknow last September, has been appointed vice chancellor of Patna University. Professor Bahl has not only had a distinguished career in research and teaching at Lucknow during the past 30 years; he has also served as president of the Zoological Society of India, foundation fellow of the National Institute of Sciences, and as a member of the University Commission of the Government of India.

B. K. Blount, at present director of Scientific Intelligence in the Ministry of Defense, has been appointed deputy secretary of Scientific and Industrial Research, to assist Ben Lockspeiser and to relieve him of some of the increasing administrative burdens.

At the **British Commonwealth Scientific Conference** delegations of scientists and research administrators from the United Kingdom, Canada, South Africa, New Zealand, Southern Rhodesia, India, Pakistan, Ceylon, and Australia assembled at Canberra Feb. 18–21, and at Melbourne Feb. 26–Mar. 7 to discuss closer collaboration among the British commonwealth nations in scientific activities. The four days between sessions were spent touring the sheep-grazing and agricultural lands that separate the two cities. Among the many subjects which the 38 scientists (including

an observer from the U. S.) considered were joint action with U. N. agencies, especially in regard to world food supplies and medical research; developments in industrial microbiology, beneficiation of low-grade ores; utilization of solar energy; agricultural engineering; and national organization of research. As in this country, the shortage of scientific and technological manpower was deemed a problem of increasing gravity, upon the solution of which optimum progress is obviously dependent. Preoccupation with the practical applications of science—so evident in the resolutions adopted and in reports of delegations to their respective governments—reflects the current concern with economic problems and prompts a question regarding the status of basic research in the British Commonwealth.

D. B. Waters, who has been with the United Kingdom Scientific Mission in Washington, has been appointed officer-in-charge of the Scottish branch of the Road Research Laboratory (DSIR), where he succeeds **R. S. Millard,** who has been made head of the bituminous section of the Materials Division of the laboratory.

Recent Deaths

George A. Alden (60), pathologist, Overbrook, Pa., Mar. 17; **Isaac Apperman** (55), internist, New York, Mar. 16; **Horace R. Bassford** (62), of Montclair, N. J., actuary, Ft. Lauderdale, Fla., Mar. 12; **Reuben B. Bauer** (56), communications expert, Brooklyn, N Y., Mar. 11; **Albert J. Bell** (—), of Cincinnati, pediatrician, Naples, Fla., Feb. 24; **Eugene B. Bennett** (70), stock breeder, Middlebury, Conn., Feb. 23; **Hans H. Blache** (77), Diesel engine expert, Copenhagen, Mar. 17; **George H. Black** (78), educator, Palo Alto, Calif., Feb. 24; **C. E. Bloch** (79), pediatrician, Copenhagen, Feb. 11; **Samuel A. Brown** (78), of Port Washington, N. Y., physician, Hobe Sound, Fla., Mar. 16; **Joseph S. Caldwell** (73), plant physiologist, Riverdale, Md., Feb. 18; **Charles B. Carlson** (68), engineer, West Orange, N. J., Feb. 10; **John F. Casey** (66), physician, Boston, Mar. 5; **Felix Castellanos** (75), educator, Guatemala City, Mar. 4; **Werrett W. Charters** (77), of Maple City, Mich., educator, Livingston, Ala., Mar. 8; **Louis Cohen** (52), clinician, Philadelphia, Feb. 22; **Edwin F. Cone** (84), metallurgist, New York, Mar. 18; **Albert S. Cook** (79), educator, Baltimore, Mar. 10; **Frank G. Cooper** (86), stomatologist, Philadelphia, Mar. 4; **Edward L. Corbett** (74), physician and patent lawyer, New York, Mar. 17.

Henry D. Dakin (72), chemist, Scarborough-on-Hudson, N. Y., Feb. 10; **Konrad Dobriner** (50), biochemist, New York, Mar. 10; **Horace Dowie** (79), electrical engineer, Chatham, N. J., Mar. 11; **Felix Ehrenhaft** (73), physicist, Vienna, Mar. 4; **William B. Fite** (82), mathematician, New York, Mar. 1; **Clarence B. Flint** (72), of Hinsdale, Ill., chemist, Vero Beach, Fla., Feb. 14; **Kenjiro Fujii** (86), cytologist, Tokyo, Jan. 11; **Domingo Galdos** (79), civil engineer, Havana, Mar. 3; **Frederick W. Hackstaff** (69), mechanical engineer, Manhasset, N. Y., Feb. 10; **Frederic R. Hamilton** (70), educator, en route from South Africa to New York, Feb. 19; **Solomon J. Harwi** (86), civil engineer, Bayonne, N. J., Mar. 17; **Hubert D. Henderson** (61), political economist, London, Feb. 22; **Herbert E. Hollander** (54), of New York, surgeon, Miami Beach, Fla., Mar. 5; **Tasker Howard, Jr.** (39), economist, Brooklyn, N. Y., Feb. 21; **John A. Hugo** (64), pathologist, Wilkes-Barre, Pa., Mar. 3; **Frank H. Hustead** (71), physician, Philadelphia, Mar. 2.

Morris W. Kellogg (79), refinery engineer, New York, Feb. 22; **Rae D. Landy** (66), retired Army nurse, Cleveland, Mar. 5; **Eugene B. Levine** (38), cardiologist, Los Angeles, Feb. 26; **Ralph S. Lillie** (76), physiologist, Chicago, Mar. 19; **A. D. Lindsay** (72), educator, Keele, Eng., Mar. 18; **Charles-Francis Long** (54), physician, Philadelphia, Feb. 28; **A. L. MacNabb** (56), veterinarian, Guelph, Ontario, Feb. 16; **Antonia C. Maury** (85), astronomer and naturalist, Hastings-on-Hudson, N. Y., Jan. 8; **Tristram W. Metcalfe** (71), educator, New York, Feb. 24; **John Millis** (93), engineer, Cleveland, Mar. 20; **John R. Mohler** (76), veterinarian, Washington, D. C., Feb. 28; **Walter W. Morey** (70), developer of the teletypesetter, Los Angeles, Mar. 9; **Charles A. Muller** (58), electrical engineer, New York, Mar. 8.

Atilio Narancio (70), physician, Montevideo, Feb. 22; **Clyde L. Patch** (64), herpetologist, Ottawa, Feb. 11; **Mildred Ragan** (61), chemist, Washington, D. C., Mar. 3; **Benjamin L. Rand** (96), of Remington Rand, Inc., North Tonawanda, N. Y., Feb. 27; **Richard G. Read** (34), Diesel engine expert, Winter Park, Fla., Feb. 18; **George B. Reitz** (61), surgeon, Brooklyn, N. Y., Feb. 23; **Bryan A. A. Rice** (57), ceramist, Rochester, N. Y., Mar. 13; **George Roemmert** (59), physician, New York, Mar. 12; **Heyman Rosenberg** (78), of New York, inventor, Hollywood, Fla., Feb. 29; **Oscar Rosenzweig** (53), hydraulic engineer, Philadelphia, Mar. 4.

Charles Sherrington (94), neurophysiologist, Eastbourne, Eng., Mar. 4; **Nevil V. Sidgwick** (78), chemist, Oxford, Eng., Mar. 16; **Alexander G. Souden** (44), chemist, Summit, N. J., Feb. 21; **Matthew Steel** (72), biochemist, Kew Gardens, N. Y., Mar. 15; **Donald C. Stockbarger** (56), physicist, Belmont, Mass., Feb. 23; **Harry Stuckert** (69), gynecologist, Baederwood, Pa., Mar. 3; **William S. Sutherland** (56), ophthalmologist, Philadelphia, Mar. 14; **Nelle Swartz** (70), social worker, New York, Mar. 5; **John M. Thomas** (82), educator, Rutland, Vt., Feb. 26; **William R. Thomson** (79), surgeon, New York, Mar. 19; **Lillia M. D. Trask** (78), former librarian, Rockefeller Institute of Medical Research, Vineyard Haven, Mass., Feb. 9; **Henry W. Turner** (79), veterinarian, New Hope, Pa., Feb. 25; **Robert J. Vane** (59), statistician, Jamaica, N. Y., Mar. 11; **Charles C. Ward** (60), of Plattsburg, N. Y., educator, Montreal, Feb. 27; **Selden G. Warner** (67), physicist, chemist, and film expert, West Orange, N. J., Feb. 27; **Adolph L. Weil** (76), former president, General Petroleum Corporation, Los Angeles, Feb. 25; **James S. Wiant** (51), plant pathologist, Summit, N. J., Mar. 15.

Association Affairs

Sessions for Contributed Papers at the Sixth St. Louis Meeting December 26–31, 1952

CONSISTENT with the spirit of the Arden House Conference, the 119th Meeting of the American Association for the Advancement of Science has a theme: "Contributions of the Sciences and Mathematics to Engineering and Industry"—and will put more emphasis on unity. A number of the Association's 18 sections and subsections will have appropriate panels or symposia. In this meeting, the concluding event of the Centennial of Engineering, it is natural that the physical and industrial sciences will play a prominent part. The other sciences and the needs of individual members to report their researches, however, will not be neglected. Already planned are other important programs—notably in the biological and medical sciences—and there will be ample arrangements for contributed papers.

Participating organizations such as the mathematical societies, the Society of Systematic Zoology, and the science teaching societies, will hold paper-reading sessions throughout the week. In addition, at least ten AAAS sections will provide opportunities for their members to read contributed papers. The 25th Newcomb Cleveland Thousand Dollar Prize (formerly the AAAS Thousand Dollar Prize) will be awarded for a noteworthy, noninvited paper read at a regular session of a particiipating society or a section. Most of the sessions sponsored by the sections will, it is anticipated, be officially co-sponsored by the societies in their fields.

The following sections are calling for papers; titles and brief abstracts should be sent to the indicated section secretary or program chairman:

C, Chemistry—Ed. F. Degering, 1860 Colonial Dr., Memphis 7, Tenn.

E, Geology and Geography—Leland Horberg, Department of Geology, University of Chicago, Chicago 37

F, Zoological Sciences—Waldo Schmitt, U. S. National Museum, Washington 25, D. C.

G, Botanical Sciences—Stanley A. Cain, School of Natural Resources, University of Michigan, Ann Arbor

H, Anthropology—Marian W. Smith, 501 W. 113th St., New York 25

I, Psychology—Delos D. Wickens, Department of Psychology, Ohio State University, Columbus 10

M, Engineering—Frank D. Carvin, Illinois Institute of Technology, Chicago 37

Nd, Dentistry—Russell W. Bunting, School of Dentistry, University of Michigan, Ann Arbor

Np, Pharmacy—George F. Archambault, U. S. Public Health Service, Washington 25, D. C.

Q, Education—Dean A. Worcester, University of Nebraska, Lincoln

Gordon Research Conferences June 16–August 29, 1952

W. George Parks

University of Rhode Island, Kingston

THE annual Gordon Research Conferences for 1952 will be held June 16–August 29 at Colby Junior College, New London, N. H., and the New Hampton School, New Hampton, N. H., under the sponsorship of the AAAS.

The conferences were established to stimulate research in universities, research foundations, and industrial laboratories. This purpose is achieved by an informal type of meeting consisting of the scheduled lectures and free discussion groups. Sufficient time is available to inspire informal discussions among the members of the conference. Meetings are held mornings and evenings, Monday through Friday, with the exception of Friday evening. The afternoons are available for recreation, reading, resting, or participation in discussion groups, as the individual desires. This type of meeting is a valuable means of disseminating information and ideas that otherwise might not reach the normal channels of publication and scientific meetings. In addition, scientists in related fields become acquainted, and valuable associations are formed that result in collaboration and cooperation among different laboratories.

It is hoped that each conference will extend the frontiers of science by fostering a free and informal exchange of ideas among people actively interested in the subjects under discussion. The purpose of the program is not to review the known fields of chemistry, but primarily to bring experts up to date as to the latest developments, to analyze the significance of these developments, and to stimulate suggestions as to the underlying theories and effective methods whereby new progress can be made. In order to protect individual rights and to promote discussion, it is an established requirement of each conference that no information presented is to be used without specific authorization of the individual making the contribution, whether in formal presentation or in discussion. Scientific publications are not prepared as emanating from the conferences.

REGISTRATION AND RESERVATIONS

Those interested in attending the conferences are requested to send in their applications to the director, on or before *May 15*. Each applicant must state the institution or company with which he is associated and the type of work in which he is most interested. Attendance at each conference is limited to 100.

The director will submit the names of those requesting attendance to the Conference Committee for each conference. This committee will review the names

and select the members in an effort to distribute the requests as widely as possible among the various institutions and laboratories represented. The names selected will be returned by the Conference Committee to the director, who will notify those accepted as soon as possible. A registration card will be mailed with the notice of selection. Advance registration by mail for each conference is required. On receipt of the completed registration card and a deposit of $25.00 made payable to the Gordon Research Conferences, AAAS, registration will be completed. The deposit of $25.00 will cover the registration fee of $15.00 (except for academic individuals and students on personal expense, who may apply for a reduction of $5.00), the balance being credited against subsistence expenses at the conference. The rates for room and meals are as follows: $2.50 per night per person in a double room with single beds; $3.00 per night per person in a single room; $3.50 per night per person in a single or double room with private bath. Meals served in the dining room are at the rate $5.75 per day per person. Gratuities are provided for by an additional charge of 10 per cent which is added to each bill. Members attending a conference are expected to live at the conference. If special circumstances warrant living elsewhere, a charge of $1.00 per day will be made to assist with the financial support of the conferences.

Each year a special fund is put at the disposal of the chairmen of the individual conferences by the Management Committee to assist scientists from academic and government institutions who cannot attend or participate at a Gordon Research Conference because of financial limitations. This fund is provided with the object of increasing the participation of research workers of academic and government institutions, and is limited to scientists and graduate students who have been invited by the chairman to attend a conference in order to present a paper or because it is expected that they will make significant contributions during their stay at the conference.

It is the responsibility of each chairman and the director of the conferences to use this fund effectively in meeting the individual needs of the academic and government participants. It may be used to contribute toward traveling and/or subsistence expenses at the conference, but the money is to be used as an assistance fund only. Total travel and subsistence expenses normally will not be paid.

A limited number of special grants are available in the amount of $200.00 each, or as much of this amount as is required, to assist qualified graduate students and postdoctoral fellows to attend a Gordon Research Conference. These students and fellows will be selected, based on the recommendation of their professors, by a committee consisting of the chairman of the conference to be attended, the chairman of the Management Committee and the director of the conferences.

If it is necessary to cancel a reservation, the notice must be received in the office of the director three weeks prior to the Conference. If such notice is received three weeks in advance of the conference, $20.00 will be refunded from the $25.00 deposit. No refund will be made for cancellations received within the three-week period.

The first meeting of each conference is held on Monday at 9:00 A.M., EDST. The morning sessions, through Friday, are scheduled from 9:00 A.M. to 12:00 noon. The second session of each day is held in the evening from 7:30 to 10:00 P.M., Monday through Thursday. Conference members are expected to release their rooms not later than Sunday morning unless they have made a reservation for the next conference.

The public lectures, sponsored jointly by the college and the Gordon Research Conferences, will be organized on Sunday evening preceding several conferences. Conference members usually arrive on Sunday afternoon preceding the conference because it is not possible to obtain public transportation Monday morning in time to arrive for the opening meeting. The schedule of these lectures has not been completed.

Accommodations are available for a limited number of women to attend each conference and for wives who wish to accompany their husbands. All such requests should be made at the time of the request for attendance, because accommodations will be assigned in the order that specific requests are received. Children under twelve years of age cannot be accommodated. Rooms are available at several inns and hotels in both New London and New Hampton if reservations are made in advance. Information on these inns and hotels will be supplied by the director on request. No dogs or other animals will be permitted in the dormitories.

Requests for attendance at the conferences or for any additional information should be addressed to W. George Parks, Director, Department of Chemistry, University of Rhode Island, Kingston, R. I. From June 15 to September 1, 1952, mail should be addressed to Colby Junior College, New London, N. H.

Program at Colby Junior College

PETROLEUM

E. C. Hughes, *Chairman*; A. H. Batchelder, *Vice Chairman*

June 16: Synthetic Detergents: L. H. Fleet, *Chairman*; A. H. Batchelder, W. K. Griesinger, C. R. Sporck, "Surface Properties of Petroleum Based Detergents;" N. Beverley Tucker, Reginald L. Wakeman, "Quarternary Ammonium Derivatives from Petroleum;" Harold Hart, "The Mechanism of the Nuclear Alkylation of Phenols."

June 17: Syntheses with the Higher Olefins: C. L. Brown, *Chairman*; M. W. Swaney, "Reactions of Olefins with Aldehydes;" C. M. Fontana, "Synthesis of V. I. Improvers with Propylene and Butene-1 and Their Performance in Engines;" W. B. Reynolds, "Elastomers and Plastics from Olefins;" J. D. Kemp, "Alkylation of Olefins with Isoparaffins;" J. N. Wilson, "The Mechanism of Hydrogenation of Propylene and of Butylenes."

June 18: Synthetic Lubricants and Oil Additives: W. A. Zisman, *Chairman*; R. C. Morris, "Some New Organo-Phosphorus Compounds as Potential Lubricants;" H. R. Fife, R. F. Holden, W. J. Toussaint, "Viscosity-Temperature Relations of Certain Polyalkylene Glycols and their Ether and Ester Derivatives;" C. M. Murphy and W. A. Zisman, "Synthetic Lubricants from New Types of Diesters;" T. W. Mastin, "Alkaline Lubricant Additives;" E. C. Knowles, "Combating Engine Deposits with Synthetic Lubricants" (tentative subject).

June 19: Liquid Propellants: A. J. Nerad, *Chairman*; A. J. Nerad, "Liquid Rocket Propulsion and the Research and Development Board;" E. H. Seymour, "Liquid Rocket Motors. Principles and Applications;" C. M. Hudson, "Performance Criteria for Liquid Propellant;" M. P. Dunnam, "Propellant Production Processes and Availability;" A. J. Nerad, "The Future;" Showing of film on V-2, Viking, or some other suitable liquid propellant vehicle. Chemistry and Physics of Detonation in Internal Combustion Engines: L. L. Withrow, *Chairman*; L. L. Withrow, "Introductory Remarks and Review of Some of the Pertinent Phenomena which Affect Adversely the Normal Inflammation Process in the Spark Ignition Engine;" Ellis Rifkin, "Sampling Valve Studies of Preflame Reactions;" P. L. Cramer and Walter Cornelius, "A Comparison of Engine Preflame Reactions with the Low Temperature Tube Oxidation Characteristics of Hydrocarbons;" B. M. Sturgis, "Chemistry of Preflame Reactions."

June 20: Antioxidants: D. R. Stevens, *Chairman*; Robert S. Mesrobian, "Organic Hydroperoxides and the Hydroperoxide Theory of Autoxidation;" Joseph A. Chenicek, "Structures of Efficient Antioxidants and their Effects on Various Petroleum Systems."

Catalysis

R. C. Hansford, *Chairman*; P. W. Selwood, *Vice Chairman*

June 23–27:

I. The Electronic Factor in Metallic Catalysts.
  A. Modern Theories of the Metallic State.
    1. Resonance Theory.
    2. Electron Band Theory.
  B. Chemisorption by Metals and Alloys.
    1. Kinetics, Mechanism, and Energetics.
  C. Catalysis by Metals and Alloys.
    1. Electronic Configuration and Lattice Parameter.

II. The Electronic Factor in Semiconductor Catalysts.
  A. Theory of Semiconductivity.
  B. Chemisorption by Semiconductors.
    1. Kinetics, Mechanism, and Energetics.
  C. Catalysis by Semiconductors.
    1. Catalysis and Semiconductivity.

III. Structural Factors in Acid (Ionic) Catalysis.
  A. Activation Processes in Acid Catalysis.
    1. Mechanism of Activation and Reaction of Hydrocarbons.
  B. Structure of "Carbonium Ion" Complexes.
    1. Configuration and Reactivity.

IV. Round-Table Discussion.
  A. Miscellaneous short contributions.
  B. General discussion of conference papers.

Longevity

W. B. Sawyer, *Chairman*

June 30–July 4: Detailed program to be announced.

High Polymers

Paul J. Flory, *Chairman*; Arthur V. Tobolsky, *Vice Chairman*

July 7: H. Mark, "Recent Developments;" P. H. Plesch, "Ionic Copolymerization;" C. S. Marvel, subject to be announced.

July 8: T. G. Fox, Jr., "Popcorn Polymerization;" A. V. Tobolsky, "Rates of Initiation in Vinyl Polymerization;" C. H. Bamford, "Synthetic Polypeptides—Preparation, Structure, and Relationship to Proteins."

July 9: R. S. Stein and S. Krimm, "Crystallization of Polyethylene;" W. H. Cobbs, Jr., and R. L. Burton, "Studies of Rapid Crystallization in Polymers;" R. F. Tuckett and A. B. Thompson, "The Drawing of Terylene."

July 10: F. T. Wall, "Polymer Diffusion and its Measurement;" H. Eisenberg, "Thermodynamics of Polyelectrolyte Solutions;" W. H. Stockmayer, "Light Scattering and Intrinsic Viscosity of Copolymers and Branched Polymers."

July 11: T. W. DeWitt, "Some Physical Properties of Concentrated Solutions of Polyisobutylene;" J. D. Ferry, "Relaxation Distribution Functions of Polymers and their Concentrated Solutions and Gels."

Textiles

W. J. Hamburger, *Chairman*; J. Edward Lynn, *Vice Chairman*

July 14: Herman F. Mark, "New Polymers for the Formation and Modification of Textile Fibers;" Bruno R. Roberts, "Influence of Some Colloid Chemical and Physical Factors on Textile Performance of Synthetic Fibers, Especially of the Acrylonitrile Type."

July 15: Kenneth L. Hertel, "Response of Fiber Assemblages to Compression as Influenced by Certain Fiber Properties;" A. G. H. Dietz, "Transmission and Attenuation of Energy in High Polymers."

July 16: Richard O. Steele, "The Relationship between the Chemical Structure and the Mechanical Behavior of Wool;" Turner Alfrey, Jr., "The Relationship between the Chemical Structure and the Mechanical Behavior of Synthetic Fibers."

July 17: Harold P. Lundgren, "Action on Wool of Certain Low Molecular Weight Reagents;" Henry M. Morgan, "Effects of Chemical Treatments on the Mechanical Behavior of Human Hair."

July 18: Orville C. Wetmore, "The Effects of Various Fabric Types on Body Comfort as Measured by Physiological Responses of Human Subjects."

Corrosion

A Critical Appraisal of Measuring Techniques

J. M. Pearson, *Chairman*; Hugh P. Godard, *Vice Chairman*

July 21: R. H. Brown, "Measurements of Characteristic Potential Behavior of a Corroding Electrode as a Function of Applied Current or as a Function of Time." Measurement of Properties of Surfaces. T. P. May, Norman Hackerman, "Measurements of Area by Adsorption of Gases;" D. C. Grahame, "Measurements of Surface Roughness by Electrical Capacity."

July 22: Measurement of Properties of Surfaces. Norman Hackerman, "Radiotracer and Radioautographic Techniques;" Leroy Schultz, "Optical and Electron-

Optical Measurement of Surface Films." Measurement of Changes in Properties of Corroding Metals. Carl A. Zapffe or Frederic Landgraf, "Fractographic Techniques and Tests for Hydrogen Embrittlement;" H. H. Uhlig, "Measurements of Passivity and their Interpretation."

July 23: Measurements of Changes in Properties of Corroding Metals. H. H. Liebhafski, "Techniques for Studying the Oxidation of Metals at High Temperatures;" F. L. LaQue, "Measurement of Damage by Cavitation, Impingement Attack, and High Velocity Erosion;" S. Logan Kerr, "Measurement of Cavitation Erosion and Correlation between Laboratory and Field Observations." Analysis of Corrosion Products and Corrosive Agents. F. N. Alquist, "Measurements of Hydrogen and Oxygen in Boiler Water."

July 24: Analysis of Corrosion Products and Corrosive Agents. C. E. Imhoff, "Analysis by X-Ray or Electron Diffraction Methods;" Armin H. Gropp, "Polarographic Analysis of Corrosion Products and Measurement of Oxygen Consumption." Statistical Treatment of Corrosion Data. O. B. Ellis, "Graphical Multiple Correlations;" V. V. Kendall, "Statistical Tools for Evaluation of Corrosion Measurements."

July 25: F. W. Fink, H. P. Godard, "Summary of 1952 Corrosion Sessions."

Instrumentation

Howard Cary, *Chairman*; William A. Wildhack, *Vice Chairman*

July 28: Richard W. Jones, "Developments in Feedback Controllers for Industrial Processes;" D. P. Campbell, "Instrumentation Methods Applied to Human Affairs."

July 29: J. W. Forrest, "Basic Requirements in Refractometry;" M. G. Jacobson, "Electrochemical Methods for Gas Analysis."

July 30: J. G. Hutton, "Mass Spectrometry;" Robert L. Wallace, "Transistor Circuitry;" Bernard S. Benson, "Trends in Automatic Data Reduction."

July 31: Robert C. Mellors, "Instrumentation for Cytological Analysis;" B. P. Dailey, "Microwave Spectra and Chemical Problems;" Richard Tousey, "Rocket Spectroscopy."

August 1: D. Goldman, "Instrumentation Problems in Biophysical Research."

In addition to the papers listed, the program will include a number of short reports to be contributed by persons attending the conference.

Food and Nutrition

Z. I. Kertesz, *Chairman*; Bacon F. Chow, *Vice Chairman*

August 4: Fats and Oils: W. O. Lundberg, "The Stability of Fats and Oils. Rancidity and its Prevention;" Fred J. Baur, "Synthetic Fats by Interesterification;" Phillip L. Harris, "Fats in Nutrition;" Paul György, "Nutritional Significance of Rancidity;" M. L. Grossman, "Fat Emulsions in Intravenous Alimentation."

August 5: Protein Nutrition: Bacon F. Chow, Introductory Remarks; Warren M. Cox, "Protein Nutrition in Restricted Caloric Intake;" Henry D. Hoberman, "Tracer Techniques in Protein Nutrition;" Winston Price, "Protein and Nucleic Acid Synthesis;" James B. Allison, "Protein Intake and Enzyme Synthesis." Fluorine and Fluoridation: Harold C. Hodge, "Mottled Enamel, Dental Caries and Fluorine;" Robert A. Kehoe, "The Toxicology of Fluorine;" C. A. Greenleaf, "Fluorides in Foods;" David B. Ast, "Fluoridation of Water Supplies."

August 6: Food Standards and Regulations: E. M. Nelson, "Nutritional Significance of Food Regulations;" A. J. Lehman, "Criteria for Safety in Foods;" F. L. Southerland, "Food Quality Standards, Their Method of Establishment and Significance;" James R. Wilson, "Therapeutic Foods." Enzymes: A. K. Balls, "Recent Developments in Enzyme Chemistry;" Carl V. Smythe, "Manufacture and Industrial Application of Enzymes;" Mildred Adams, "Enzymes as Analytical Tools."

August 7: Interrelationships between the Endocrine System and Nutritional Processes: Louis Levin, Introductory Remarks; Roy Hertz, "The Participation of Dietary Trace Factors in the Metabolic Effects of Hormones;" Dwight Ingle, "Caloric Intake as an Important Variable in Endocrine Research;" Benjamin H. Ershoff, "The Effects of Vitamin Malnutrition on Resistance to Stress." Food and Feed Production through Culture of Microorganisms: Leslie R. Hedrick, "Fat and Protein Production by Molds and Bacteria;" Simon S. Jackel, "Food and Feed Yeast;" A. W. Fisher, Jr., "Growing Algae for Food."

August 8: Infant Food and Infant Feeding: R. B. Wakefield, "Processed Infant Foods;" L. A. Baur, "Developments in Infant Foods Containing Milk Products;" Victor Najjar, "Recent Developments in Infant Feeding."

Vitamins and Metabolism

Gladys A. Emerson, *Chairman*; B. Connor Johnson, *Vice Chairman*

August 11: B. Connor Johnson, "The Metabolism of Radioactive Nicotinic Acid in the Rat;" Herschel K. Mitchell, "Problems of the Biosynthesis and Degradation of Tryptophan;" Herbert P. Sarrett and Grace A. Goldsmith, "The Metabolism of Nicotinic Acid in Man."

August 12: T. F. Zucker and Lois M. Zucker, "Establishing Criteria for the Selection of Experimental Animals;" W. J. Darby, "Methods of Assaying the Nutritional Requirements of Man;" Grace A. Goldsmith, "Recommended Daily Allowances of Vitamins."

August 13: George W. Kidder and Virginia Dewey, "The Nutritional Requirements of *Tetrahymena*;" Ellsworth Dougherty, "The Nutritional Requirements of the Nematode;" Gerald F. Combs, "Recent Research in Chick Nutrition, Particularly in Reference to the Requirements of the Chick for Unidentified Growth Factors;" J. R. Couch, "Unidentified Factors Required for Hatchability;" Damon Catron, "Newer Aspects of Swine Nutrition."

August 14: L. J. Reed, "The Isolation and Chemical Nature of Lipoic Acid;" I. C. Gunsalus, "Biological Functions of Lipoic Acid;" E. L. R. Stokstad, "The Isolation and Properties of Protogen;" L. D. Wright and D. E. Wolf, "Studies with Biocytin;" Harry Waisman, "Metabolic Studies in Acute Leukemia Treated with Antagonists."

August 15: V. Cheldelin, "Bound Forms of Pantothenic Acid;" E. E. Snell, "*Lactobacillus bulgaricus* Factor;" W. W. Westerfeld and D. A. Richert, "The Xanthine Oxidase Factor."

Medicinal Chemistry

Charles A. Winter, *Chairman*; Jackson P. English, *Vice Chairman*

August 18: J. A. Wells, "An Experimental Approach to Shock;" Robert Pennell, "Plasma Extenders;" H. J. White, "A Screening Test for Antituberculous Activity in Mice;" Edmund Mayer, "Experimental Embolic Pulmonary Tuberculosis in Mice."

August 19: Hubert Bloch, "Virulence Factors in Tuberculosis;" Dr. Nissen-Meyer, "BCG in Tuberculosis Control;" Robert J. Schnitzer, "Laboratory Evaluation of Antitubercular Drugs;" Irvin J. Selikoff and Edward H. Robitzek, "Therapy of Human Tuberculosis with Hydrazine of Isonicotinic Acid and its Derivatives."

August 20: Brian Hutchings, "Chemistry of Aureomycin;" Coy Waller, "Chemistry of Aureomycin;" James H. Boothe, "Chemistry of Aureomycin;" Speaker to be announced, "Antibiotic Chemistry;" Speaker to be announced, "Antibiotic Chemistry."

August 21: Emanuel Schoenbach, "Current Clinical Status of Antibiotics;" Werner K. Maas, "Studies on the Biochemical Mechanism of Bacterial Resistance to Drugs;" D. L. Tabern, "The Use of Radioisotopes in Medicinal Chemistry."

August 22: Maurice S. Raben, "Chemistry and Biology of the Growth Hormone;" R. B. Woodward, "Total Synthesis of Sterols."

Cancer

G. Burroughs Mider, *Chairman*; Alfred Gellhorn, *Vice Chairman*

August 25: Georgiana Bonser, "A Study of the Aromatic Amines in Relation to Carcinogenesis with Special Reference to β-naphthylamine;" C. Lenore Simpson, "Trypan Blue Induced Tumors in Rat Liver;" Arthur Vorwald, "Pulmonary Cancer Induced by Beryllium Compounds Deposited in the Lungs of White Rats;" Joseph Beard, "Avian Leucosis, A Template for Cancer Research."

August 26: George Palade, "Recent Progress in the Study of Cell Structure;" Cyrus Barnum, "Some Aspects of the Chemical and Metabolic Heterogeneity of Cytoplasm;" Alexander Dounce, "Chemistry of the Nucleus and Nucleolus;" J. Murray Luck, "The Incorporation of Labelled Amino Acids by Liver Histone—*in vitro* and *in vivo* Studies;" Henry Hoberman, "Studies on the Kinetics of Formation of Nuclear Proteins."

August 27: Charles Heidelberger, "Studies of Nucleic Acid and Protein Biosynthesis in Tumor-Bearing Rats;" Leon Miller, "Studies in Protein Synthesis in Experimental Tumors;" Henry Lemon, "Comparison of Proteins in Human Neoplasms and Homologous Tissues of Origin. (a) Acid Phosphomonoesterases, (b) Desoxypentose Nucleoproteins." The evening session will be a round-table discussion.

August 28: Arthur Walpole, "Association Among Growth-Inhibitory, Carcinogenic and Mutagenic Activity of Ethyleneamine Derivatives;" Erich Hirschberg, "Studies on the Mechanism of Action of 8-Azaguanine, Cortisone and Nitrogen Mustard;" Joseph Leiter, "The Action of Compounds Derived from Podophyllin on Tissue Function and Metabolism;" Alice Moore, subject to be announced; Joseph Ross, "The Mechanism of Anemia Associated with Neoplastic Disease."

August 29: Leon Jacobson, "Evidence for a Humoral Factor (or Factors) Concerned in Recovery from Radiation Injury;" Arthur Kirshbaum, "Host Factors in Resisting the Development in Radiation Induced Neoplasms and Radio Resistance of Experimental Lymphomas."

Program at New Hampton School

Organic Coatings

R. W. Quarles, *Chairman*; Henry Grinsfelder, *Vice Chairman*

June 16: L. E. Hoag, "Properties of Very Thin Coatings;" H. H. Uhlig, "Chemistry and Physics of Metal Surfaces."

June 17: H. Rosenbloom, "Chemistry of Wash Primers;" W. M. Bright, "Adhesion and the Adhesive Action of Thermoplastic Films."

June 18: F. W. Reinhart, "Deterioration of Polymeric Coatings;" S. C. Horning, E. B. Fitzgerald, "Deterioration of Alkyd and Oleoresinous Coatings."

June 19: W. K. Asbeck, J. T. Bergen, "Flow Properties of Pigmented Systems;" E. I. Stearns, "Measurement of Color and Appearance of Coatings."

June 20: F. Schofield, "Test Methods and Testing of Coatings."

Nuclear Chemistry

Glenn T. Seaborg and C. D. Coryell, *Co-Chairmen*

June 23: M. Goldhaber and G. Scharf, "Nuclear Physics for Nuclear Chemists;" G. T. Seaborg, N. Sugarman, L. Marquez, J. M. Miller, I. Perlman, A. L. Thompson, A. L. Turkevich, E. O. Wiig, "High Energy Nuclear Reactions."

June 24: G. T. Seaborg, N. Sugarman, L. Marquez, J. M. Miller, I. Perlman, A. L. Thompson, A. L. Turkevich, E. O. Wiig, "High Energy Nuclear Reactions;" I. Perlman, C. D. Coryell, G. T. Seaborg, T. P. Kohman, "Decay Energetics and Systematics."

June 25: C. D. Coryell, L. E. Glendenin, R. W. Spence, N. Sugarman, A. L. Turkevich, "Nuclear Fission;" J. W. Kennedy, G. E. Boyd, A. W. Adamson, R. W. Dodson, "Tracers, Exchange Reactions (including report from the A.C.S. Notre Dame Conference)."

June 26: J. E. Willard, R. R. Edwards, W. H. Hamill, R. R. Williams, Jr., "Hot Atom Chemistry;" G. Friedlander, C. J. Borkowski, A. Ghiorso, "Techniques."

June 27: J. J. Katz, B. B. Cunningham, J. C. Hindman, "Heavy Element Chemistry."

Elastomers

J. D. D'Ianni, *Chairman*; Maurice Morton, *Vice Chairman*

June 30: Emulsion Polymerization Variables. E. J. Meehan, "Some Fundamentals of Emulsion Polymerization;" M. Morton, "Loci in Emulsion Polymerization." Physical Properties of Latex. E. G. Cockbain, "Colloidal Stability of Rubber Latices;" S. H. Maron, "Determination of Synthetic Latex Particle Size and its Distribution."

July 1: Dynamic Properties—Effect of Molecular Weight and other Parameters. I. L. Hopkins, "Shear Dynamics in the Rubbery State;" T. W. DeWitt, "Some Dynamic Studies on Fractions of Diene Polymers;" R. M. Pierson, "Effect of Free End Fraction of Vulcanizate on Resilience Properties."

July 2: Crystallization Phenomena and Structural

Effects. W. B. Reynolds, "Hydrogenated Polymers;" F. M. Rugg, "Infrared Structural Studies on Polyethylene and Changes in Oxidation;" W. S. Richardson, "The Influence of Polymerization Conditions on the Structure of Diene Polymers;" B. M. G. Zwicker, "Plasticizers for Polyvinyl Chloride."

July 3: Chemistry of Vulcanization. B. C. Barton, "Mechanism of Sulfur Vulcanization of Rubber;" H. E. Adams, "Cross-Linking in Natural Rubber Vulcanizates;" I. Auerbach, "Radioactive Sulfur in Vulcanization Studies."

July 4: Degradation Studies. R. Simha, "Free Radical Mechanism of Degradation;" E. G. Cockbain, "Cold Mastication of Natural Rubber;" E. K. Gladding, "Oxidation of Neoprene."

Ion Exchange

K. A. Kraus, *Chairman*; W. Juda, *Vice Chairman*

July 7: Round-table discussion on new ion exchange materials, properties, and techniques. Discussion: I. M. Abrams, C. Calmon, W. E. Katz, R. Kunin, R. Wheaton. H. Deuel, P. Smit, "Ion Exchange in Europe."

July 8: Applications. P. Smit, S. M. Cantor, "Carbohydrate Purification;" G. W. Busby, "Glycerin Purification;" R. G. Denkewalter, "Streptomycin Preparation;" D. M. Surgenor, "Blood Treatment."

July 9: H. Deuel, "Selective Reactions of Ion Exchangers;" H. Deuel, "Cation Exchange of Organic Derivatives of Clays;" H. C. Thomas, "Chromatography and Adsorption Isotherms;" N. K. Hiester, "Counter Current Ion Exchange Systems;" B. A. Soldano, "Ion Exchange Kinetics."

July 10: G. Scatchard, "Ion Exchange Electrodes;" R. A. Plane, "Cation and Anion Exchange of Metal Complexes;" M. R. J. Wyllie, W. A. McRae, "Electrochemistry of Natural and Synthetic Ion Exchange Membranes."

July 11: W. C. Bauman, "The Economics of Ion Exchange."

Chemistry and Physics of Metals

David Turnbull, *Chairman*; Thor N. Rhodin, Jr., *Vice Chairman*

July 14: J. H. Hollomon, "Formal Theory for the Kinetics of Phase Transformations;" Clarence Zener, "Atomic Mobility in Solids;" Henry Eyring, "Application of Absolute Rate Theory to Phase Transformations."

July 15: N. Cabrera, "Mechanism of Crystal Growth;" A. H. Geisler, "Crystallographic Relations in Phase Transformations;" Bruce Chalmers, "Kinetics of Solidification and Dendrite Formation."

July 16: F. N. Rhines, "Nucleation and Growth Mechanism of Order-Disorder Transitions;" B. E. Warren, "Kinetics of Order-Disorder Transitions of the Second Kind;" J. C. Fisher, "Theory for the Size, Shape, and Rate of Formation of Precipitates from Solid Solutions."

July 17: B. L. Averbach, "Nature of Solid Solutions Prior to Precipitation;" Charles A. Wert, "The Application of Anelasticity to the Study of Precipitation;" Morris Cohen, "Kinetics of Martensite-Type Transitions."

July 18: T. A. Read, "Kinetics of Allotropic Transformations in Certain Alloys;" L. J. E. Hofer, "Reactions of Carbides of Iron, Cobalt, and Nickel;" I. E. Campbell, "Kinetics of Metal Deposition."

July 21–25: Separation and Purification Processes: John R. Bowman, *Chairman*.

Statistics

Conduct of Experimental Investigation

W. J. Youden, *Chairman*

July 28: The Nature of Experimental Investigations: W. J. Youden, *Chairman*; E. K. Carver and George E. Kimball, "Philosophy of Experimentation." G. M. Cox, *Chairman*; E. B. Wilson, "Some Aspects of Scientific Methods;" D. B. DeLury, "Limitations of Statistics."

July 29: Increasing the Sensitivity of Experiments: Westman, *Chairman*; S. L. Crump, "Sensitivity of Experiments;" Hugh Smallwood, "An Example of Fractional Replication;" Boyd Harshbarger, *Chairman*; R. J. Monroe, "The Purpose of Experimental Designs;" David Frazier, "Example of Incomplete Blocks."

July 30: Increasing the Sensitivity of Experiments (*continued*): Cuthbert Daniel, *Chairman*; G. A. Bennett, "Increasing Precision of Measurements;" Jerome Cornfield, "Determination of Sample Size;" Forman Acton, "Fitting Straight Lines." Interaction of Experimental Factors: T. A. Bancroft, *Chairman*; G. W. Wernimont, "Meaning of Interaction;" R. L. Anderson, "Philosophy of Interaction;" H. C. Batson, "Factorial Chi Square."

July 31: Evaluation of Test Methods: Matthews, *Chairman*; O. D. Peakes, "Fundamentals of a Test Method;" Shreve, "Evaluation of Analytical Methods." Hugh Smallwood, *Chairman*; Questions and Answers.

August 1: Presentation of Experimental Results: F. Wilcoxin, *Chairman*; J. A. Anderson, "Presentation of Experimental Results;" W. J. Dixon, "Rejection of Observations."

Steroid Chemistry

Carl Djerassi, *Chairman*

August 4: Plant Steroids. M. E. Wall, M. M. Krider, E. S. Rothman, and C. R. Eddy, "Isolation and Characterization of Steroidal Sapogenins and Saponins;" T. D. Fountaine and H. M. Doukas, "Recent Chemical Work on Plant Steroids;" A. Hunger and T. Reichstein, "Recent Work on Cardiac Glycosides;" O. Wintersteiner and J. Fried, "Jervine."

August 5: Biochemical Methods. H. Levy and A. S. Meyer, "Chemical Transformations of Steroids by Adrenal Perfusion;" A. Zaffaroni, "Biochemical Oxidation of Steroids;" J. Schneider, "Metabolism of Adrenocortical Hormones."

August 6: Total Synthesis. S. Swaminathan, D. Perry, and M. S. Newman, "Total Synthetic Approaches to Cortisone;" W. S. Johnson, "Total Synthesis of Steroids."

August 7: Partial Synthesis. A. Dreiding, "Transformations of Ring A;" T. F. Gallagher, "Recent Chemical Work on Adrenal Steroids;" P. L. Julian, "Partial Synthesis of Adrenal Steroids."

August 8: Speakers and subjects to be announced.

Current Trends in Analytical Chemistry

Organic Analysis

J. J. Lingane, *Chairman*; Harry Levine, *Vice Chairman*

August 11–15: L. T. Hallett, "Elemental Analysis;"

E. W. D. Huffman, "Elemental Analysis;" R. H. Müller, "Instrumentation of Paper Chromatography;" John Sease, "Chromatography;" J. Mitchell, "Determination of Functional Groups by Karl Fischer Reagent;" S. Siggia, "Current Aspects of Functional Group Analysis;" S. Wawzonek, "Organic Polarography;" P. J. Elving, "Determination of Compounds as Compounds;" N. Coggeshall, "Spectroscopic Functional Analysis;" Paul Kirk, "Ultra-Micro Techniques;" T. Higuchi, "Metal Hydrides in Organic Analysis."

INORGANIC CHEMISTRY

Therald Moeller, *Chairman*; Eugene O. Brimm, *Vice Chairman*

August 18: A. N. Holden, Discussion Leader. New Research Tools as Applied to Inorganic Chemistry. S. H. Bauer, "Diffraction."

August 19: New Research Tools as Applied to Inorganic Chemistry. S. Freed, "Spectroscopy."

August 20: J. J. Katz, "Non stoichiometric Compounds."

August 21: E. L. Zebroski, "Solvent Extraction in Inorganic Chemistry."

August 22: Summary and discussion.

COAL

Coal Combustion and Gasification

G. D. Creelman, *Chairman*; A. C. Fieldner, *Vice Chairman*

August 25: J. W. Gartland, "X-Ray Studies of Coal and Carbon During Conversion;" J. I. Yellott, "Combustion Reactions."

August 26: Properties and Reactions of Coal Ash. E. G. Bailey, "Practical Aspects;" R. C. Corey, "Theoretical Aspects."

August 27: M. A. Elliott, E. Gorin, A. A. Orning, C. C. Wright, "Kinetics and Mechanisms of Gasification and Combustion Reactions."

August 28: M. A. Elliott, E. Gorin, A. A. Orning, C. C. Wright, "Kinetics and Mechanisms of Gasification and Combustion Reactions."

August 29: Round Table. Significance of Fundamental Studies of Combustion and Gasification.

Laurentian Hormone Conference

Gregory Pincus

The Worcester Foundation for Experimental Biology

THE Laurentian Hormone Conference of the AAAS will hold its 1952 meeting at Mont Tremblant Lodge, Mont Tremblant, Que., during the period September 7–12. The Committee on Arrangements invites applications for attendance from interested investigators and from specialists in the hormone field. Since accommodations at the hotel necessarily limit the attendance, application must be made to the Committee on Arrangements, 222 Maple Ave., Shrewsbury, Mass. In order to be considered, application blanks must be received by the committee by *June 5*.

The following program has been arranged:

I. CHEMISTRY AND BIOCHEMISTRY OF ADRENOCORTICOSTEROIDS

"Synthesis of 11-Oxygenated Adrenal Hormones from Plant Steroids," G. Rosenkrantz; "Hydrolysis and Extraction of Corticoids and 17-Ketosteroids from Body Fluids," E. H. Venning; "Micro-methods for the Analysis of Adrenocortical Steroids," A. Saffaroni; "The Bioassay of Adrenocorticosteroids," R. I. Dorfman.

II. ADRENOCORTICAL PHYSIOLOGY

Symposium on Diseases of Adaptation

"The Diseases of Adaptation," H. Selye; "Some Experimentally Produced and Some Naturally Occurring Pathologic Changes in the Rat," D. J. Ingle, B. L. Baker; "Studies on Adrenal Cortical Function in Man," G. W. Thorn; "The Adaptation Concept in Relation to Connective Tissue Disease," W. Bauer; "The Adrenal in Cancer," C. Huggins, D. M. Bergenstal.

III. PHYSIOLOGY OF REPRODUCTION

"Progesterone Metabolism in the Human Female: Its Significance in Relation to Reproduction," H. S. Guterman; "The Biochemistry of Relaxin," E. H. Frieden, F. L. Hisaw; "Problems of Fetal Endocrinology: Gonadal and Hypophyseal Hormones," A. Jost; "The Influence of Steroids on Uterine Metabolism," C. Szego, S. Roberts.

IV. GROWTH HORMONE AND METABOLISM

"Growth and Diabetes," F. G. Young; "The Effects of Anterior Pituitary and Adrenal Cortical Hormones on Carbohydrate Metabolism," R. C. deBodo; "The Biosynthesis of Lipids *in vitro* and its Hormonal Control," S. Gurin, R. O. Brady.

Technical Papers

Effect of Phosphorylated Hesperidin, a Hyaluronidase Inhibitor, on Fertility in the Rat

Gustav J. Martin and J. M. Beiler

Research Laboratories, The National Drug Company, Philadelphia, Pennsylvania

Four experimental observations led to the currently recorded experiments. McClean and Rowlands (*1*) and Fekete and Duran-Reynals (*2*) have reported that the ovum in the fallopian tube is covered with follicular cells embedded in a thick viscous gel, chemically consisting primarily of hyaluronic acid (*3*). The sperm cannot penetrate the ovum unless the outer hyaluronic acid gel layer is dispersed. McClean and Rowlands (*1*) found that testicular hyaluronidase added to recently ovulated ova causes a dispersion of the follicular cells, denuding the ova and thus permitting sperm penetration. Clearly, the mechanism is dependent upon the activity of hyaluronidase, and a highly effective inhibitor of hyaluronidase should block fertility. *In vitro* and *in vivo* studies (*5*) have demonstrated the capacity of hyaluronidase inhibitors to prevent the follicle-cell-dispersing activity of rabbit sperm hyaluronidase and to act as contraceptives. Phosphorylated hesperidin (*4*) is a powerful inhibitor of hyaluronidase and is nontoxic. We therefore undertook to determine the capacity of phosphorylated hesperidin as a hyaluronidase inhibitor to produce sterility.

The fertility experiments were done with rats, in groups of three, each cage containing one male, one control female, and one female being given phosphorylated hesperidin. In cages where the control females did not deliver, the results were not included in the final tabulation. This served as a check on the fertility of the males used. Females were examined periodically for vaginal plugs to insure that coitus had taken place. The phosphorylated hesperidin was given either intraperitoneally at 20 mg/kg or orally at 100 mg/kg. In each case the controls were treated with equal volumes of saline or water.

The experiments were continued until two weeks after the last control delivery. At this time the animals were separated and treatment with phosphorylated hesperidin was stopped. The animals were kept under observation for a further three-week period, and were then remated with the males, this time without being given phosphorylated hesperidin.

Phosphorylated hesperidin was found to be an effective antifertility agent, whether administered intraperitoneally or orally. In the group receiving the compound orally, 6 rats out of 30, or 20%, became pregnant and had successful deliveries. In the group being given intraperitoneal injections, 4 rats out of 24 rats, or 17%, delivered. Thus, of a total of 54 rats, conception was prevented in 44. Since the cages in which the control rats did not conceive were discarded, the control rate has been 100%. In no cage where a control rat failed to conceive did an experimental animal become pregnant.

Approximately 80% of the experimental animals became pregnant when they were remated after treatment with the phosphorylated hesperidin was stopped. The material when administered only to the males had no effect; the action appears to be specifically on the female. Examination of vaginal smears showed that the estrus cycle remains normal during the administration of phosphorylated hesperidin.

The results reported here, although striking, must be considered to be merely preliminary, because of the small number of animals used. Further work, with much larger numbers of animals, is now in progress.

References

1. McClean, D., and Rowlands, I. W. *Nature*, **150**, 627 (1942.)
2. Fekete, E., and Duran-Reynals, F. *Proc. Soc. Exptl. Biol. Med.*, **52**, 119 (1942).
3. Meyer, K., and Palmer, J. W. *Am. J. Ophthalmology*, **19**, 859 (1936).
4. Beiler, J. M., and Martin, G. J. *J. Biol. Chem.*, **174**, 31 (1948).
5. Pincus, G., Pirie, N. W., and Chang, M. C. *Arch. Biochem.*, **19**, 388 (1948).

Manuscript received January 12, 1952.

Uracil Protection against Ultraviolet Radiation Damage to a Higher Plant

H. S. Puleston, Jess L. Fults, and Merle G. Payne[1]

Colorado A and M College, Fort Collins

It is known that sublethal ultraviolet irradiation of bacteria and plants damages the cell division mechanism and inhibits growth (*1, 2*).

Limperos and Mosher (*3*) have shown that thiourea will reduce the mortality rate of x-irradiated mice. They have theorized that this reduction of mortality may be due to protection of the nucleic acids of the cell by thiourea. One of the basic constituents of the nucleic acids of the cell is uracil. That pyrimidine derivatives are destroyed by ultraviolet light has been shown by Rapport and Canzanelli (*4*). Sinsheimer and Hastings (*5*) have likewise found that irradiation with ultraviolet light for 15 hr at a pH of 7.0 caused a 63% loss in the maximum absorption of uracil. Puleston (*6*) has shown that bacteria, treated with a lethal dose of ultraviolet light, can be both reactivated and protected from the effects of this radiation by uracil.

The present paper is concerned with the measure-

[1] Published with the approval of the director, Colorado Agricultural Experiment Station, as Scientific Series Paper No. 367.

TABLE 1

THE PROTECTIVE EFFECT OF URACIL AGAINST ULTRAVIOLET RADIATION (2537 A)* DAMAGE ON ALASKA PEA SEEDLINGS

Variance analyses						
Variability due to	D/F†	Sums of squares	Mean squares	Observed F	Required F .05	.01
1. Control (sprayed with distilled water and irradiated) —Treatment (500 μg uracil)						
Totals	23	6.098				
Between treatments	1	1.402	1.402	6.56	4.30	7.94
Within treatments	22	4.696	0.213			
Standard deviation = 0.46 Standard error = 0.42						
Mean growth for control = 2.41 cm; and for treated = 2.93 cm, with a difference of 0.52 cm						
Minimum difference required for significance at .05 level, 0.39; at .01 level, 0.53						
2. Control (sprayed with distilled water and irradiated) —Treatment (.000 μg uracil)						
Totals	23	11.311				
Between treatments	1	3.700	3.700	10.70	4.30	7.94
Within treatments	22	7.611	0.346			
Standard deviation = 0.59 Standard error = 0.17						
Mean growth for control = 2.41 cm; and for treated = 3.23 cm, with a difference of 0.82 cm						
Minimum difference required for significance at .05 level, 0.50; at .01 level, 0.68						

* A 30-w GE germicidal tube No. G-30, T-8 (mercury arc) at a distance of 20 cm. This tube operates on the principle of the fluorescent tube, but the glass of the tube is clear and of a special type which passes a particular wavelength of ultraviolet. About 95% of this ultraviolet energy is in the region of 2537 A—the most effective germicidal energy.

† D/F = degrees of freedom.

ment of the effect of uracil in protecting 6-day-old etiolated Alaska pea seedlings against ultraviolet radiation (2537 A, Table 1).

Seedlings were sprayed with solutions of uracil and irradiated for 30 min. Approximately 25 ml of spray was used on each lot of 60 seedlings. Each lot consisted of 12 bands containing 5 seedlings each, making a total of 60 plants per lot. Three types of controls were used. One was sprayed with distilled water and irradiated, one not sprayed but irradiated, and one sprayed with 1000 μg of uracil but not irradiated. Details are given in Table 1 and in the following discussion. Height measurements before and 48 hr after treatment were used as a measure of the effectiveness of uracil as a protector against ultraviolet radiation damage.

The variance analyses show that 500 μg of uracil sprayed on pea seedlings significantly protected them from ultraviolet radiation damage at the 5% level and that 1000 μg of uracil significantly protected them at the 1% level. Uracil at the rate of 200 μg gave no significant protection.

When comparisons were made between the following two control lots, one receiving no uracil, no irradiation, and no water spray, the other receiving 1000 μg of uracil spray but no irradiation, differences were not significant. This demonstrated the lack of phytotoxicity of uracil at this level.

These results are in accordance with the results previously observed by Puleston on *Streptococcus faecalis* R. The present work suggests that uracil has a similar protective action for a higher plant.

References

1. HINSHELWOOD, C. N. *Chemical Kinetics of the Bacterial Cell.* Oxford: Clarendon Press, 232 (1946).
2. NICKERSON, J. *Nature*, **162**, 241 (1948).
3. LIMPEROS, G., and MOSHER, W. A. *Science*, **112**, 86 (1950).
4. RAPPORT, D., and CANZANELLI, A. *Ibid.*, 469.
5. SINSHEIMER, R. L., and HASTINGS, R. *Ibid.*, **110**, 525 (1950).
6. PULESTON, H. S. Ph.D. thesis, Dept. Chemistry, Univ. Colorado (1950).

Manuscript received November 5, 1951.

Metabolic Relationship between *Meso*-Inositol and Lindane

A. S. Srivastava[1, 2]

Department of Economic Entomology, University of Wisconsin, Madison

A close relationship of the spatial configuration of *meso*-inositol and lindane (γ-benzene hexachloride) molecules was reported (*1*) in 1945, and following this observation workers (*2–8*) have investigated the mechanism of this interrelationship on a variety of organisms. In insects (*9–10*), however, no inhibition of the γ-isomer by *meso*- or *m*-inositol has been found after the simultaneous administration of these compounds.

The purpose of this note is to determine whether there exists any metabolic relationship between *meso*-inositol and lindane in the German cockroach, *Blattella germanica* Linn. For this investigation one female roach carrying the egg pod was placed in each of 16 battery jars containing roach food (*11*) (10 parts whole wheat flour, 9 parts dried skim milk powder, and 1 part dry baker's yeast) mixed with *meso*-inositol in percentages of 0, 0.5, 1–10, 15, and 25. The hatching date of each pod was noted, and the nymphs were allowed to feed in the battery jars for 38 days.

A group of 10 roaches bred on each concentration of inositol was placed in three Petri dishes separately containing the same roach food (*11*), mixed with 0.1% γ-, 10% α-, and 10% β-isomers of benzene hexachloride, respectively. Each dish contained a cir-

[1] State Scholar of the government of India. Permanent address: 464, Subash Nagar, Allahabad 2 (U. P.), India.

[2] Grateful acknowledgement is made to H. F. Wilson, University of Wisconsin, for his valuable helpful suggestions. Thanks are expressed to the government of India for the award of a State Scholarship to continue this work.

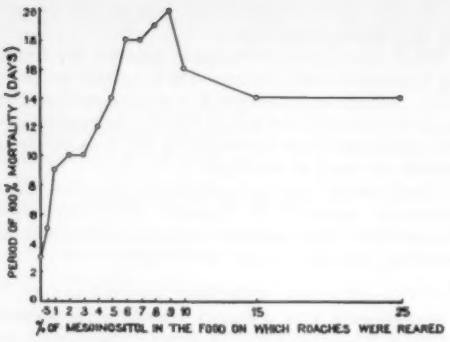


FIG. 1. Extent to which *meso*-inositol inhibits the action of the γ-isomer. Curve showing the period of 100% mortality of roaches when fed food containing 0.1% γ-isomer. The roaches were previously allowed to feed for 38 days from the time of hatching in food containing various concentrations of *meso*-inositol. Av temp, 80° F; relative humidity, 60%.

cular piece of white paper occupying the whole area, and two small vials, one filled with poisoned food and the other containing water plugged with cotton wool. The period of 100% mortality of roaches was then recorded for each dish. Controls were also run. The results of the experiment in which the roaches were tested on 0.1% of the γ-isomer have been plotted in Fig. 1.

It is evident that the roaches reared on 9% *meso*-inositol have maximum resistance, with 100% mortality occurring only after 20 days on food with 0.1% γ. As the concentration of the inositol was decreased from 9%, the period for 100% mortality was also decreased. If, on the other hand, the concentration of inositol was increased above 9%, the survival period also decreased. The results with 10% α-isomer in the food were quite inconsistent in relation to the inositol concentration. The β-isomer at the 10% level was nontoxic.

The maximum inhibition of the γ-isomer was shown at 9% *meso*-inositol concentration, but even at this level it did not completely neutralize the toxic action. It is suggested that there may be several metabolites affected in the cells by the γ-isomer, and *meso*-inositol may perhaps be one of these, although there does not appear to be a direct metabolic relationship between the two and the inhibition shown in these insects may be due to resistance acquired or developed by them after feeding on this vitamin. Moreover, the γ-isomer molecule is not isomorphous with that of *meso*-inositol (*12*).

References

1. SLADE, R. E. *Chemistry & Industry*, (40), 314 (1945).
2. BUSTON, H. W., JACOBS, S. E., and GOLDSTEIN, A. *Nature*, **158**, 22 (1946).
3. KIRKWOOD, S., and PHILLIPS, P. H. *J. Biol. Chem.*, **163**, 251 (1946).
4. LANE, R. L., and WILLIAMS, R. J. *Arch. Biochem.*, **19**, 329 (1948).
5. FISCHER, E. H., and BERNFELD, P. *Helv. Chim. Acta*, **32**, 1146 (1949).
6. SCHWIMMER, S., and BALLS, A. K. *J. Biol. Chem.*, **179**, 1063 (1949).
7. FULLER, R. C., BARRATT, R. W., and TATUM, E. L. *Ibid.*, **186**, 823 (1950).
8. SARMA, P. S. *Current Sci.* (India), **19**, 315 (1950).
9. METCALF, R. L. *J. Econ. Entomol.*, **40**, 522 (1947).
10. DRESDEN, D., and KRIJGSMAN, B. J. *Bull. Entomol. Research*, **38**, 575 (1948).
11. SRIVASTAVA, A. S. *Indian Med. Record*, **71**, (2), 43 (1951).
12. VAN VLOTEN, G. W., *et al. Nature*, **162**, 771 (1948).

Manuscript received July 30, 1951.

Serological Differentiation of Fish Bloods

John E. Cushing

Department of Biological Sciences,
Santa Barbara College of the University of California
Santa Barbara, California

The need for methods by which separate breeding populations can be readily distinguished within single species of fish has prompted the present investigation of the serological properties of fish bloods. The purpose has been to discover individual variations in the blood of fishes analogous to those that have been studied by anthropologists interested in the evolution and migrations of human populations (*1, 2*). If such variations could be discovered in fish, it might be hoped that further work would produce information of value in separating races within such fishes as the tunas, the salmons, and the Pacific sardines. In addition, it is possible that these serological variations could be used as markers by which the movements of fish populations could be followed in the sea.

The present note is prompted by the discovery of individual variation in the agglutinin content in the bloods of yellow fin tuna, *Neothunnus macropterus* (Temminck and Schlegel), and skipjack, *Katsuwonus pelamis* (Linnaeus).[1]

Whole blood samples were frozen immediately upon collection from living fish and were shipped frozen to this laboratory. Investigation has shown that the large amount of hemoglobin that is released by the lysed erythrocytes in blood treated in this way apparently has no significant effect on such observations as those reported below.

The bloods were found to be separable into four distinct groups on the basis of their agglutinin content (Table 1). Absorption experiments have revealed that the agglutinins that differentiate these types include one specific for human antigen B, one specific for all human cells tested, and one specific for sheep cells.

In addition to these agglutinins, an antigen in tuna blood similar to the human A substance is indicated by the fact that rabbit antituna serum agglutinates human A cells specifically and that tuna serum specifically inhibits human anti-A typing serum. As yet, no individual variations in this inhibiton have been

[1] Bloods of individuals of the two species of tuna referred to were obtained through the efforts of John L. Kask and Fred C. June, Pacific Oceanic Fisheries Investigations, U. S. Fish and Wildlife Service, Honolulu. The author is indebted to them for the careful preparations that have made this study possible.

TABLE 1

A SUMMARY OF INDIVIDUAL VARIATIONS NOTED IN THE AGGLUTINATION OF ERYTHROCYTES BY TUNA BLOODS

Species and group	Human cells (type)				Sheep cells
	A	B	AB	O	
Tuna					
Group 1 (1 fish)	0*	+†	+	0	+
Group 2 (1 ")	+	+	+	+	0
Group 3 (12 ")	0	+	+	0	0
Group 4 (6 ")	0	0	0	0	0
Skipjack					
Group 1 (6 fish)	0	+	+	0	0
Group 2 (1 ")	0	0	0	0	0

* 0 = no agglutination.
† + = definite agglutination.

established, all fish that have been investigated showing the effect.

Finally, it should be noted that in these studies human sera have been found to contain agglutinins that react with the erythrocyte antigens of a variety of species of fish (*3*). These include the anti-B agglutinin and several that are distinct from the classical anti-A and anti-B agglutinins. Detailed reports on these observations will be published. Other reports on the serological differentiation of fish bloods that are known to the author are three dealing with differences in individual eel sera with respect to their ability to agglutinate human type O cells (*4–6*), and one (*7*) dealing with the use of the precipitin technique in demonstrating differences in the serum antigens of a variety of species of marine and freshwater fishes.

References

1. BOYD, W. C. *Genetics and the Races of Man.* Boston: Little, Brown (1950).
2. WIENER, A. S. *Blood Groups and Transfusion,* 3rd ed. Springfield, Ill.: Thomas (1943).
3. CUSHING, J. E., and SPRAGUE, L. Unpublished manuscript.
4. GRUBB, R. *Acta path. microbiol. scand.,* Suppl. 84, 1 (1949).
5. JONSSON, B. *Ibid.,* Suppl. 54, 456 (1944).
6. SUGISHITA, S. *Juzenkwai Zasshi,* **40**, H. 11, S. 4643 (cit. from [*5*]) (1935).
7. GEMEROY, D. G. *Zoologica,* **28**, Pt. 3, 109 (1943).

Manuscript received November 23, 1951.

Comments and Communications

Lobbyist for American Science

WADSWORTH LIKELY'S timely and pertinent article in SCIENCE of October 12, 1951, missed perfection by a single omission: We feel he should have added, "Support the Federation of American Scientists."

How well the federation has filled the role of lobbyist for American science or, as we prefer to think, lobbyist for the best interests of the country as they are affected by science, is well known to most of the scientific fraternity. A measure of our inadequacy is, perhaps, that Mr. Likely seems to have overlooked us.

Since the successful fight in 1946 for civilian control of atomic energy, for which the FAS has been given much of the credit, we have maintained an office and staff in Washington. We have sent regular news bulletins to our membership, innumerable special releases to the press, and calls for action at critical times to our membership and to the public at large. Our advice is sought and respected on Capitol Hill, in the executive agencies of the government and by the press.

In the areas of secrecy and security, we have exerted a salutary and cumulative profound influence on the regulations and procedures of the Atomic Energy Commission and defense agencies. We were active throughout the fight for a National Science Foundation. We opposed special security clearance for employees and fellows of the foundation. In most of the issues raised as Congress deals with the now apparent importance of science to the national welfare, we have had influence far beyond our numerical strength.

The federation should be stronger. We hope that all those concerned with science and the national welfare share the convictions of Mr. Likely. They should know, however, that the edifice need not be designed and built. It need only be enlarged and strengthened.

LYLE B. BORST

Federation of American Scientists
Washington, D. C.

Geography at Harvard

THE Institute of Geographical Exploration went out of existence Oct. 1, 1951. The institute, although part of Harvard University, was privately financed and directed by Hamilton Rice, the noted Amazon explorer.

During its lifetime of twenty years, the institute gave instruction in cartography, aerosurveying, field communications, field surveying, and exploration in general. The map collection of 102,000 modern maps and atlases is the largest in New England. The library of 20,000 volumes specialized in books on exploration. Instruments were often lent to explorers, and Dr. Rice sponsored several notable expeditions, such as those of Bradford Washburn, Arthur B. Emmons, Jr., and many others.

Three years ago the university dismissed the entire geography staff with the exception of D. S. Whittlesey. A special committee last year recommended the

re-establishment of geography, but no action was taken. Dr. Rice, discouraged by the policy of the university to discontinue geography, withdrew his support of the institute. The building is now closed, pending the decision of the university as to its further use.

It is too soon for the staff of the institute to have completed plans for the future, but Edward S. Wood, Jr., expert in aerophotography, is going on with his consulting jobs, and Erwin Raisz is continuing at his workshop in Cambridge.

ERWIN RAISZ

107 Washington Ave., Cambridge, Massachusetts

Radiation Sensitivity of Benzene-d_6[1]

OF ORGANIC compounds, the aromatic are the most resistant to radiation, and of these the most resistant heretofore reported is benzene (*1*). For example, it is less sensitive to decomposition by high-energy radiation than aliphatic hydrocarbons by a factor approximating 100. It has been shown (*2*) that the 100 ev yields of gaseous products from liquid benzene irradiated with 1.5-mev electrons from a HVEC Van de Graaff generator are, respectively, $G(H_2) \simeq 0.037$ and $G(C_2H_2) \simeq 0.022$.

We have now examined the radiation chemistry of benzene-d_6 and find that it is even more resistant to high-energy radiation than benzene, with yields $G(D_2) \sim 0.011$ and $G(C_2D_2) \sim 0.013$. These results are undoubtedly to be correlated with differences of zero-point energy of C-H and C-D and perhaps of C-C vibrations in the two compounds, but no simple relationship can be expected. The fact that $G(H_2) > G(C_2H_2)$, whereas $G(D_2) < G(C_2D_2)$, suggests that in radiolysis benzene decomposes by at least two essentially different processes.

It is noteworthy that benzene-d_6 has the lowest currently known radiation sensitivity of any liquid organic substance.

SHEFFIELD GORDON[2]
MILTON BURTON

Department of Chemistry
University of Notre Dame

[1] Contribution from the Radiation Chemistry Project operated by the University of Notre Dame under Atomic Energy Contract AT(11-1)-38.

References

1. BURTON, M. *J. Chem. Education*, **28**, 404 (1951).
2. MANION, J. P., and BURTON, M. *J. Phys. Chem.* (in press).

[2] Present address: Chemistry Division, Argonne National Laboratory, Chicago, Ill.

Scientific Book Register

Copolymerization. Turner Alfrey, Jr., John J. Bohrer, and H. Mark. New York–London: Interscience, 1952. 269 pp. $6.80.

Urine and the Urinary Sediment: A Practical Manual and Atlas. Richard W. Lippman. Springfield, Ill.: Thomas, 1952. 124 pp. $7.50.

The Action of Hormones in Plants and Invertebrates. Reprinted, with additions and supplementary bibliographies, from ***The Hormones,*** Vol. I. Kenneth V. Thimann, Ed. New York: Academic Press, 1952. 228 pp. $5.80.

The Explanation of Human Behaviour. F. V. Smith. London: Constable; New York: Macmillan, 1951. 276 pp. $2.75.

Classical Mechanics. D. E. Rutherford. Edinburgh–London: Oliver and Boyd; New York: Interscience, 1951. 200 pp. $2.25.

Plastics Molding. John Delmonte. New York: Wiley; London: Chapman & Hall, 1952. 493 pp. $9.00.

The Lebesgue Integral. Cambridge Tracts in Mathematics and Mathematical Physics, No. 40. J. C. Burkill. New York: Cambridge Univ. Press, 1951. 87 pp. $2.50.

Plane Table Mapping. Julian W. Low. New York: Harper, 1952. 365 pp. $5.00.

Essentials of Histology. 2nd ed. Margaret M. Hoskins and Gerrit Bevelander. St. Louis, Mo.: Mosby, 1952. 240 pp. $4.00.

The Principle of Relativity. A collection of original memoirs on the special and general theory of relativity by H. A. Lorentz, A. Einstein, H. Minkowski, and H. Weyl. Reissue. New York: Dover, 1952. 216 pp. $1.50; cloth, $3.50.

Drugs and Solutions. Harold N. Wright and Mildred Montag. Philadelphia: Saunders, 1952. 91 pp. $1.75.

A Laboratory Manual for Geology, Part II: ***Historical Geology.*** Kirtley F. Mather and Chalmer J. Roy. New York: Appleton-Century-Crofts, 1952. 96 pp. and worksheets. $2.75.

Electrical Communications Experiments. Henry R. Reed, T. C. Gordon Wagner, and George F. Corcoran. New York: Wiley; London: Chapman & Hall, 1952. 458 pp. $6.75.

Journeys and Voyages to Nature: A Survey of One Hundred Books. J. Christian Bay. Chicago: John Crerar Library, 1951. 67 pp. $2.00.

The Hand of God: A Study of the Creation of Man, Mind, and the Universe. Harriet Chaffey Payne. New York: Exposition Press, 1952. 107 pp. $2.50.

Partial Differentiation. R. P. Gillespie. Edinburgh–London: Oliver and Boyd; New York: Interscience, 1951. 106 pp. $1.95.

Textbook of Organic Chemistry. 3rd ed. George Holmes Richter. New York: Wiley; London: Chapman & Hall, 1952. 762 pp. $6.75.

A Sex Guide to Happy Marriage. 1st Am. ed. Edward F. Griffith. New York: Emerson Books, 1952. 352 pp. $3.00.

Nutrition and Climatic Stress: With Particular Reference to Man. H. H. Mitchell and Marjorie Edman. Springfield, Ill.: Thomas, 1951. 234 pp. $6.75.

Connective Tissue. Transactions of the Second Conference, May 24–25, 1951, New York. Charles Ragan, Ed. New York: Josiah Macy, Jr. Fdn., 1952. 190 pp. $3.50.

WILEY BOOKS

GENERAL BIOLOGY, New Third Edition

By PERRY D. STRAUSBAUGH, *West Virginia University, and* BERNAL R. WEIMER, *Bethany College.* This edition retains the "all life is one" approach of former editions, which made it a favorite beginners' text. The authors present a logical integration of biological facts, making possible the treatment of life as a unified concept. They develop the study of plants and animals simultaneously, and treat both as living things which carry on the same general life functions, with their differences appearing only in structure and in the nature of machinery by which they carry on their work.

This edition stresses scientific method; the discussion of enzymes and their importance in all life processes has been brought up-to-date; the sections on respiration, genetics, and the plant kingdom have been completely revised. *April 1952. Approx. 828 pages. Prob. $6.00.*

A NEW MANUAL for the BIOLOGY LABORATORY

Second Edition By BERNAL R. WEIMER *and* EARL L. CORE, *West Virginia University.* Three major revisions make the second edition more effective and useful: (1) outline drawings are bound in with appropriate text instead of being placed at the end; (2) space for student answers is left after each question; (3) all pages have been perforated and punched for two- and three-ring notebooks. *1952. Prob. $2.75.*

PRINCIPLES of GEOCHEMISTRY

By BRIAN MASON, *Indiana University.* This book summarizes the significant facts and ideas concerning the chemistry of the earth, and synthesizes these data into a coherent treatment of its physical and chemical evolution. *April 1952. 276 pages. $5.00.*

HETEROCYCLIC COMPOUNDS, Volumes III and IV

Edited by ROBERT C. ELDERFIELD, *University of Michigan.* VOLUME III covers the Polycyclic Derivatives of Pyrrole; Polycyclic Systems with One Nitrogen Common to Both Rings; Pyrindine and Related Compounds. *April 1952. 442 pages. $12.00.* VOLUME IV covers the general principles and type reactions of Quinoline, Isoquinoline, and their Benzo Derivatives. *April 1952. 674 pages. $17.00.*

ELEMENTARY ANALYSIS

By KENNETH O. MAY, *Carleton College.* A straightforward book designed for an integrated beginning course or a terminal course, *Elementary Analysis* gives the student a good grasp of the logical nature of mathematics, the algebra of numbers, analytical geometry, and the simpler ideas of calculus by organizing all its topics around a few significant ideas. *April 1952. Approx. 600 pages. Prob. $5.00.*

Send for on-approval copies today.

JOHN WILEY & SONS, Inc. **440 Fourth Avenue, New York 16, N.Y.**

TWENTY-EIGHTH ANNUAL MEETING

SOUTHWESTERN DIVISION - AAAS

jointly with the

COLORADO–WYOMING ACADEMY OF SCIENCE

May 1–4 at the University of Colorado

Boulder, Colorado

Boulder is 25 minutes from Denver on this turnpike

For Information

On the meeting, write Frank E. E. Germann, University of Colorado

On Boulder and its environs, write the Secretary, Boulder Chamber of Commerce

NEW McGraw-Hill Books

SOILS AND SOIL FERTILITY

By Louis M. Thompson, Iowa State College. *McGraw-Hill Series in Agriculture.* Ready in April.

Designed for an elementary college course in soils, this text places particular emphasis on the formation and classifications of soils, soil fertility and uses of fertilizers, and maintenance of organic matter and soil conservation. The first six chapters deal with the physical, biological, and chemical properties of soils, and the formation and classification of soils. The remaining chapters deals with fertility and management.

FUNDAMENTALS OF FRUIT PRODUCTION. New 3rd Edition

By V. R. Gardner, U. S. Department of Agriculture, F. C. Bradford and H. D. Hooker, Jr. *McGraw-Hill Publications in the Agricultural Sciences.* In press

Explains in an orderly, systematic manner how the basic underlying principles of plant anatomy, morphology and physiology, and of soil science and climatology apply to the culture of fruit plants. Emphasis is on principles underlying growth and culture, not the details of practices. The treatment deals principally with the more common deciduous fruits. However, much illustrative material is drawn from non-deciduous fruits and other crop plants. The scope is world-wide.

INVERTEBRATE FOSSILS

By Raymond C. Moore, C. C. Lalicker, and A. G. Fischer, University of Kansas. Ready in June

A well-organized, comprehensive, descriptive guide to all important fossils. It is designed to serve as a text for college courses in Introductory Invertebrate Paleontology, and as a handbook for academic geologists and practicing geologists in oil and other mineral industries. Over 400 line drawings illustrate the more than 2,000 fossils described.

GEOLOGY

By O. D. von Engeln, Cornell University, and Kenneth E. Caster, University of Cincinnati. Ready in May

A basic text covering both physical and historical geology, this book starts with geologic phenomena familiar to the student, and, following this consideration of physical geology, presents the facts of historical geology as an outgrowth of the former. A strong narrative continuity is maintained throughout with logical sequences of chapters and topics.

Send for copies on approval

McGRAW-HILL BOOK COMPANY, Inc.

330 West 42nd Street **New York 36, N. Y.**

Will serve you well—as they have served thousands of biologists throughout the world for over thirty years. The importance of these items to human welfare far transcends their monetary value and The Coleman & Bell Company appreciates this responsibility by producing biological stains that are always *dependable*. All of the stains in common use have been tested by the Biological Stain Commission.

C & B Products are distributed by
Laboratory and Physician Supply Houses
Throughout the World

Catalog Upon Request. THE COLEMAN & BELL Co., Inc.
Manufacturing Chemists, Norwood, O., U.S.A.

COLEMAN & BELL

TRYPTOPHAN-FREE

CASEIN

HYDROLYSATE

SPECIAL CHEMICALS DIVISION

Winthrop-Stearns INC.

1450 BROADWAY, NEW YORK 18, N. Y.

FOR ROUTINE HIGH-CENTRIFUGAL FORCE

An ultracentrifuge to concentrate, purify, and classify macromolecules and colloidal materials—proteins, viruses, enzymes, chemical precipitates, etc.

Interchangeable angle-type rotors run in vacuum chamber equipped with refrigeration for controlled rotor temperatures.

Automatic electronic controls govern the entire fast cycle of operation, monitor the self-balancing quiet 40,000-rpm electric drive. Double armor-steel guard and interlocks combine safety with dependability.

Send for complete information on
Model L Preparative Ultracentrifuge

spinco **SPECIALIZED INSTRUMENTS CORPORATION**
605 O'NEILL AVE., BELMONT, CALIF.

SCIENTISTS AND LABORATORY TECHNICIANS

Insist Upon the BEST . . . . .

ALCONOX® WORLD FAMOUS DETERGENT

No matter what you want to clean . . . blood, encrusted pipettes, metalware, porcelain ware, machine parts, instruments, . . . no matter how dirty or greasy they may be . . . ALCONOX will make them sparkling clean, film-free, streakless.

In soft or hard water, ALCONOX is equally effective. It actually lifts off dirt, grime and grease faster than anything you have ever tried.

SAVES ENERGY, SAVES TIME

Just wash and rinse. Toweling practically unnecessary. Economical too—one spoonful makes a gallon of active cleanser ready to go to work on your toughest job.

Available In:
Box of 3 lbs. — Price $ 1.95
Carton (12 x 3 lb.) ea. 18.00
Bag of 50 lb. lb. .40
Barrel of 300 lb. .37
(slightly higher on Pacific Coast)

If your dealer cannot supply you, write for literature and samples.

ALCONOX WETTING AGENT — **ALCONOX, INC.** 61-63 Cornelison Ave., Jersey City 4, N. J. — ALCONOX DETERGENT

Save time...labor...

Feed Purina Laboratory Chow

Busy . . . then simplify your animal care with Purina Laboratory Chow. No mixing, no guesswork . . . one feed meets the nutritional requirements of most laboratory animals. You will find it's clean and easy to feed in its convenient Checker form.

Tested by scientists for scientists, Purina Laboratory Chow provides an unchanging diet for laboratory animals.

There's a Purina Dealer near you. See him today for fresh Purina Laboratory Chow, or write our Laboratory Chow Department for information.

RALSTON PURINA COMPANY, St. Louis 2, Missouri

AMINO ACIDS
for
Biochemical
Biological and Microbiological
INVESTIGATIONS

85
AMINO ACIDS

Write for Revised Catalogue S 950 Listing a Complete Selection of Over 500 Important Biochemicals

Nutritional Biochemicals Corporation
CLEVELAND 28, OHIO

LaMOTTE

COMBINATION SWIMMING POOL SET

for small pools and those who do not care to install separate units for chlorine and alkalinity.

This unit is applicable to the ranges of chlorine and alkalinity actually required for swimming pool water, and will enable the operator to keep his alkalinity and chlorine values between the limits required by State Health Department specifications.

They are complete with 3 color standards for each test representing the upper and lower limits of chlorine (0.2, 0.5, 0.7) and alkalinity (pH 7.2, 7.6, & 8.0) together with reagents and necessary glassware.

These units are contained in a plastic comparator block, the top of which serves for making tests. The plastic blocks are moisture resistant and ideal for use around pools.

LaMotte Chemical Products Company
Dept. "H" Towson, Baltimore 4, Md.

Meetings & Conferences

Apr. 21. American Institute of Chemical Engineers. Symposium on Corrosion. Akron, Ohio.
Apr. 21–22. Industrial Accident Prevention Association (Annual). Royal York Hotel, Toronto.
Apr. 21–24. Institute of Labor Relations and Social Security (Annual). New York University.
Apr. 21–24. Society of Automotive Engineers (National Aeronautic Meeting and Aircraft Engineering Display). Hotel Statler, New York.
Apr. 21–25. American College of Physicians (Annual). Public Auditorium, Cleveland.
Apr. 21–25. Society of Motion Picture and Television Engineers (Semiannual). Drake Hotel, Chicago.
Apr. 21–26. Educational Television Programs Institute. Nittany Lion Inn, Pennsylvania State College.
Apr. 22–24. American Industrial Hygiene Association. Cincinnati.
Apr. 22–24. Society of Chemical Industry Conference on Adhesion. Leeds.
Apr. 22–26. International Congress of Otoneuro-Ophthalmology. Lisbon and Estoril, Portugal.
Apr. 23–26. National Association of Foreign Student Advisers. East Lansing, Mich.
Apr. 24–25. American Academy of Neurology. Brown Hotel, Louisville, Ky.
Apr. 24–25. Pennsylvania Manufacturing Confectioners' Association (Annual Production Conference). Lehigh University, Bethlehem.
Apr. 24–26. American Philosophical Society (Annual). Philadelphia.
Apr. 25–26. American Mathematical Society (Eastern), Columbia University, New York; (Western), University of Chicago.
Apr. 25–26. Arkansas Academy of Science. Jonesboro.
Apr. 25–26. Midwestern Psychological Association. Cleveland.
Apr. 25–26. National Office Management Association. Chalfonte-Haddon Hall, Atlantic City.
Apr. 25–26. Western Psychological Association. Fresno, Calif.
Apr. 26. Catholic Round Table of Science, Pennsylvania Chapter (Spring). Mount Mercy College, Pittsburgh.
Apr. 26–May 4. Science Fair. Franklin Institute, Philadelphia.
Apr. 26–May 11. Foire International de Liége. Liége, Belgium.
Apr. 27–May 1. American Ceramic Society (Annual). William Penn Hotel, Pittsburgh.
Apr. 28–30. American Oil Chemists' Society (Spring). Shamrock Hotel, Houston.
Apr. 28–30. Fisheries Council (Annual). Vancouver, B. C., Canada.
Apr. 28–30. National Academy of Sciences. Washington, D. C.
Apr. 29. International Hydrographic Conference. Bureau Hydrographique Internationale. Monte Carlo.
Apr. 29–30. Metal Powder Show and Metal Powder Association (Annual). Drake Hotel, Chicago.
Apr. 30–May 2. Natural Gasoline Association of America (Annual). Rice Hotel, Houston.
May 1–2. American Venereal Disease Association and Experimental Therapeutics Study Section of National Institutes of Health, Symposium on Venereal Diseases (Annual). Washington, D. C.
May 1–3. American Goiter Association. St. Louis.

RADIO-ACTIVE STEROIDS

Immediately Available

Estrone 16-C^{14}

Activity per mg.	Price per mg.
2.7 microcuries	$50.00

Progesterone 21-C^{14}

Activity per mg.	Price per mg.
2.25 microcuries	$40.00

Desoxycorticosterone acetate 21-C^{14}

Activity per mg.	Price per mg.
2.25 microcuries	$40.00

Form A.E.C. 374 and Form N.R.C.-C.R. 247 (Canada) must accompany each order.

For further information, write to:

Charles E. Frosst & Co.

P. O. Box 247

Montreal **Canada**

WONDERFUL RECORDINGS OF 121 BIRD SONGS

TWO albums of vinylite records bring 121 different bird songs right into your home. These recordings, made in the birds' natural habitats, feature North American warblers, birds of the woods, fields, sea coasts and prairies.

A few of the 121 birds that sing for you on these records:

Bluebird	Tufted Titmouse
Starling	Canada Warbler
Limpkin	Red-eyed Towhee

- An announcer identifies each bird before it sings
- Attractively packaged in decorative albums that make wonderful gifts

Recorded for the Albert R. Brand Bird Song Foundation, Laboratory of Ornithology, Cornell University

VOLUME I
Six 10" records, 12 sides, $8.50 postpaid

VOLUME II
Five 12" records, ten sides, $10.50, postpaid

ALL RECORDS FOR 78 R.P.M. MACHINES
15% DISCOUNT TO SCHOOLS

MAIL THIS COUPON TODAY!

To: COMSTOCK PUBLISHING ASSOCIATES
(Formerly Comstock Publishing Company, a division of Cornell University Press)
125 Roberts Place, Ithaca, New York

Please send me ..... albums of Bird Songs, Volume I @ $8.50 each, and ..... albums of Bird Songs, Volume II @ $10.50 each, postpaid.

Name .....

Address .....

City ..... Zone ..... State .....

PERSONNEL PLACEMENT

YOUR ad here reaches over 32,000 foremost scientists in the leading educational institutions, industrial laboratories, and research foundations in the U. S. and 76 foreign countries—at a very low cost

CLASSIFIED: 15¢ per word, minimum charge $3.00. Use of Box Number counts as 10 additional words.

DISPLAY: $17.50 per inch, no charge for Box Number.

Correct payment to SCIENCE must accompany all ads. Insertion usually made 2 or 3 weeks after receipt of ad.

SCIENCE • 1515 Mass. Ave., N.W., Wash. 5, D. C.

POSITIONS WANTED

Bacteriologist: A.B., M.S., two years study toward Ph.D. in pharmacology. Two years research in parasitology. Veteran, married, Sigma Xi, publications. Desire instructor or research associate position. Available in July, 1952. Box 154, SCIENCE. 4/11

Botanist, 28, Ph.D. Desires academic position. General botany, ecology, taxonomy. Box 168, SCIENCE. X

Biochemist, Ph.D., desires responsible position. Sixteen years experience planning, conducting, and directing research programs. Teaching experience. Box 165, SCIENCE. X

Geologist, Ph.D., teacher college geology, long exerience, desires teaching or laboratory position. Box 167, SCIENCE. X

Graduating physiologist, Ph.D., male, age 32, family, desires academic-research position. Publications. Teaching experience. References available. Box 161 SCIENCE. X

Microbiologist-biochemist. Ph.D. in physical chemistry, 6 years post-doctoral research in microbiology, biochemistry, plant physiology. Desires academic appointment with good research opportunity. Box 164, SCIENCE. X

Positions Wanted:
(a) M.S. (Vertebrate Zoology); two years, research assistant, department of genetics, eastern university. **(b) M.S.** (Mycology-Microbiology); graduate course, medical mycology, industrial mycology; six years, research microbiologist, well known company. For further information, please write Science Division, Medical Bureau, Palmolive Building, Chicago. X

Physiologist, Ph.D. in June, male, General, Comparative and Mammalian Physiology, desires acadamic position with research opportunities. Research in Endocrinology and General Physiology.

Plant Pathologist-Microbiologist, Ph.D., age 31, experienced in research and teaching; publications. Desires academic or industrial position. Box 157, SCIENCE. 4/11

Physiologist: Ph.D. Age 36. Experienced teacher, active researcher (metabolism, enzymology). Outstanding scholastic record. NRC Fellow. Medical school or University position. Box 162, SCIENCE. X

Zoologist, parasitologist. Ph.D. U. of M. Many publications. Broad teaching and research experience. Prefer combination teaching and research. T. Vergeer, 50 East 15, Holland, Michigan. X

Zoologist, biologist. Ph.D. Twenty years successful college teaching. Producer of many graduate, medical students wants position in stable progressive college. Box 160, SCIENCE. X

Zoologist: Ph.D., 15 years research and teaching experience: protozoology, parasitology, cellular physiology and growth. Numerous publications. Desires university or medical school professorship. Box 145, SCIENCE. 4/4, 11

POSITIONS OPEN

Educational Representative—To contact teachers in medical and allied schools, colleges and schools of nursing in Canada and Michigan, comprising provinces of British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia, Newfoundland. College graduate 25–30 years old, science background and teaching experience preferred. Knowledge of French desirable but not required. This is a full-time, salaried position with all expenses paid. Write P.O. Box 416, Phila. 5, Penna., U.S.A. 4/18

POSITIONS OPEN

Electron Microscopist—Physics or physical chemistry major with experience in electron microscopy. Permanent. Salary open. Pleasant living and working conditions in expanding research group. Location—Ponca City, Oklahoma. State age, experience, education and salary desired in opening letter. Write direct to Personnel Records Division, Continental Oil Company, Ponca City, Oklahoma. X

Positions Open:
(a) Director, new laboratory organized for toxicological investigation of new organic compounds; M.D. or Ph.D. trained in pharmacology, biochemistry, biophysics or enzyme chemistry; East. **(b) Industrial Hygienist;** Bachelor's in chemistry, chemical engineering or biology required; new plant, South. **(c) Senior Pharmacologist,** Ph.D. or M.D., qualified to initiate and develop pharmacological research program; important company; East. **(d) Professor and Head,** department of Physiology and Pharmacology; university medical school; $8500–$10,000. **(e) Director of Research;** Ph.D. or M.D.; should have flair for pure research; duties include some product development work; East. **(f) Medical Editor;** pharmaceutical company, East. **(g) Biochemist or Chemical Engineer;** research appointment; large industrial company; Midwest. S4-2 Science Division, Medical Bureau (Burneice Larson, Director) Palmolive Building, Chicago. X

Physiologist. Ph.D. or M.D. Research facilities available. Opening for assistant professor and instructor. Send complete information to Dr. E. W. Hawthorne, Head Dept. of Physiology, College of Medicine, Howard University, Washington, D. C. 4/18

THE UNIVERSITY OF SYDNEY
WALTER MERSH STRONG RESEARCH FELLOWSHIP

Applications are invited from persons qualified for appointment to the Walter Mersh Strong Research Fellowship.

The Fellowship is available for the purpose of conducting original research in Papua in any of the biological, physical or social sciences related to Papua or in Papuan History or Linguistics.

The Fellowship shall be for one or two years' duration at a salary of £800 to £1,100 per annum (plus cost of living adjustment; males £182 and females £138 per annum) depending on age, experience and qualifications of the successful applicant.

In addition to the salary, grants not exceeding £500 per annum, according to requirements will be made to meet the travelling and field expenses of the Fellow while engaged upon research work in Papua.

Full particulars of the conditions of award may be obtained from the undersigned, with whom applications close on 30th June, 1952.

W. H. MAZE, Registrar

YOU can TELL and SELL over 32,000 top scientists here . . . at a very low cost.

Your sales message in an ad this size costs only $43.75 at the one-time rate—less for multiple insertions. And the results!—well, here's what one of the many satisfied advertisers in SCIENCE has to say . . .

"SCIENCE is consistently our most profitable medium. Business secured solely thru SCIENCE ads has been the backbone of our success in this field."

"We carry a considerable amount of advertising in various periodicals, but none is so productive of results as SCIENCE."

Prove to yourself the effectiveness of SCIENCE in increasing your Market, Sales, and PROFITS—send your "Copy" NOW—or write for further information and Rate card No. 27B.

SCIENCE *weekly reaches over 32,000 top scientists* **1515 Mass. Ave., N.W., Wash. 5, D. C.**

The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

YOUR ad here reaches over 32,000 foremost scientists in the leading educational institutions, industrial laboratories, and research foundations in the U. S. and 76 foreign countries—at a very low cost

CLASSIFIED: 20¢ per word, minimum charge $5.00. Use of Box Number counts as 10 additional words. Correct payment to SCIENCE must accompany ad.

DISPLAY: Rates listed below—no charge for Box Number. Monthly invoices will be sent on a charge account basis—providing satisfactory credit is established.

Single insertion	**$17.50 per inch**
7 times in 1 year	**16.00 per inch**
13 times in 1 year	**14.00 per inch**
26 times in 1 year	**12.50 per inch**
52 times in 1 year	**11.00 per inch**

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

BOOKS

WANTED TO PURCHASE . . .

SCIENTIFIC PERIODICALS and BOOKS

Sets and runs, foreign and domestic. Entire libraries and smaller collections wanted.

WALTER J. JOHNSON • 125 East 23rd St., New York 10, N. Y.

Your sets and files of scientific journals

are needed by our library and institutional customers. Please send us lists and description of periodical files you are willing to sell at high market prices. Write Dept. A3S, J. S. CANNER, INC. Boston 19, Massachusetts

SCIENTIFIC BOOKS and PERIODICALS WANTED

Complete libraries—Sets and runs—Single titles
Also, please send us your want lists.

STECHERT - HAFNER, INC.
31 East 10th St., New York 3

YOU reach over 32,000 scientists in these columns—at a very low cost

PROFESSIONAL SERVICES

LOOKING FOR A PUBLISHER?

Write for Free Booklet SC telling how we can publish your book. All subjects considered. New authors welcome.

VANTAGE PRESS, Inc. 230 W. 41 St., New York 18.

FOOD RESEARCH LABORATORIES, INC.
Founded 1922
Philip B. Hawk, Ph.D., President
Bernard L. Oser, Ph.D., Director
Research • Analyses • Consultation
Biological, Nutritional, Toxicological Studies for the Food, Drug and Allied Industries
48-14 33rd Street, Long Island City 1, N.Y.

• RESEARCH
• CONSULTATION
• ANALYSES

LOOK AROUND... notice the increasing number of satisfied advertisers using small-space ads regularly in practically every issue of SCIENCE—*proof that these small ads get results!* If you have a product or service of interest to scientists, why not take advantage of this low-cost means of increasing your profits!

PROFESSIONAL SERVICES

ANNOUNCING

POST-GRADUATE INSTRUCTION IN HOMOEOPATHY
24th Session
POST-GRADUATE SCHOOL
American Foundation for Homoeopathy
Time: June 30 to August 8, 1952.
Place: Senexet House, Putnam, Connecticut.
Write to Foundation Secretary: Julia M. Green, M.D.
1726 Eye Street, N.W. Washington 6, D. C.

WISCONSIN ALUMNI RESEARCH FOUNDATION

LABORATORY SERVICES
in Biochemistry, Chemistry, Bacteriology and Insecticide Testing

Vitamin assays including biological assays for vitamins A, D_2, D_3, E and K

Amino acid assays and biological protein evaluations

Write for price schedule

WISCONSIN ALUMNI RESEARCH FOUNDATION
P. O. BOX 2059 • MADISON 1, WISCONSIN

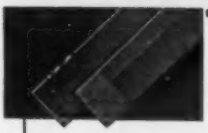
SUPPLIES AND EQUIPMENT

***automatic* Washers**

for Pipettes • Animal Cages • Laboratory Glassware

Please send for literature

HEINICKE Instrument Corp. • P.O. Box 2072 Hollywood, Florida



SAF-T-GRIP
BEADED EDGE

MICROSCOPE SLIDES
NON-CORROSIVE • NON-FOGGING

- Smooth, diamond-processed *beaded* edge—won't slip or slide from hand—eliminates cuts from sharp edges.
- Made from water-clear glass—entirely free from flaws—guaranteed non-corrosive.
- Available in two types—plain or with frosted end for easy marking.
- Economical—even as compared with ordinary sharp-edged slides.

Write for prices, further information and samples.

PROPPER MANUFACTURING CO., INC.
10-34 44th Drive, Long Island City 1, New York

The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

SUPPLIES AND EQUIPMENT

STAINS
STARKMAN Biological Laboratory
• RARE
• COMMON
Price list on Request
• 461 Bloor St., W. Toronto, Canada

MATCHED VISCOSITY TUBES

For the air-bubble method of comparing viscosities. Simplest method of determining viscosity on medium to heavy bodied liquids. Widely used in the varnish industry.
Write for leaflet V-5.

R. P. Cargille 118 Liberty Street New York 6, N. Y.

• HYPOPHYSECTOMIZED RATS

Shipped to all points via Air Express
For further information write
HORMONE ASSAY LABORATORIES, Inc. • 808 E. 58th St. Chicago 37, Ill.

All AMINO ACIDS— natural, synthetic, unnatural, Rare Sugars, Biochemical Products, Reagents, New Pharmaceuticals in stock. Write or phone PLaza 7-8171 for complete price list.
BIOS LABORATORIES, INC. 17 West 60th Street, New York 23, N. Y.

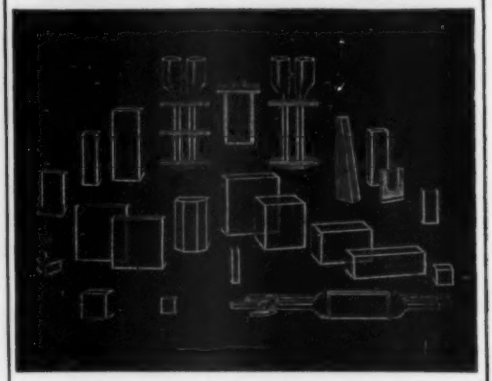
BIND 'EM... and you'll find them!

Keep your copies of SCIENCE always available for quick, easy reference in this attractive, practical binder. Simply snap the magazine in or out in a few seconds—no punching or mutilating. It opens FLAT—for easy reference and readability. Sturdily constructed—holds 26 issues.

This beautiful maroon buckram binder stamped in gold leaf will make a fine addition to your library. Only $2.75 postpaid (personal check or money order please). Name, 70¢ extra—year of issue, 40¢ extra. ORDER YOURS NOW!

SCIENCE • 1515 Mass. Ave., N.W., Washington 5, D. C.

GLASS ABSORPTION CELLS made by ***KLETT***



Makers of Complete Electrophoresus Apparatus

SCIENTIFIC APPARATUS
Klett-Summerson Photoelectric Colorimeters—Colorimeters — Nephelometers — Fluorimeters—Bio-Colorimeters — Comparators — Glass Standards—Klett Reagents.

Klett Manufacturing Co.
179 East 87 Street, New York, New York

VALUABLE IN STUDIES OF SUGAR METABOLISM
Phosphorylated Sugars
Schwarz

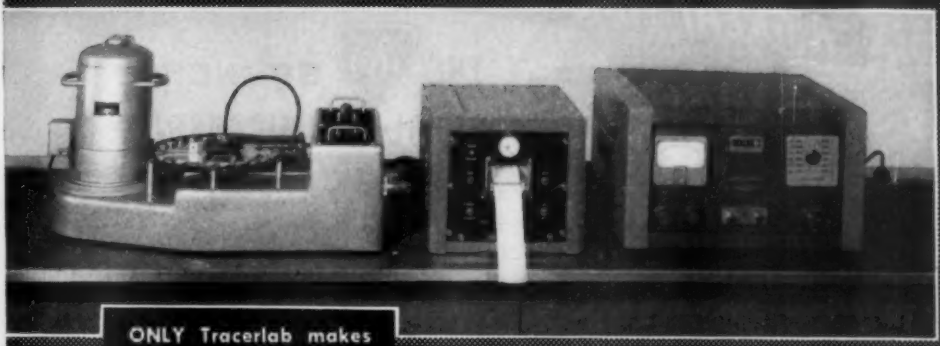
Fructose-6-phosphate (barium salt), *glucose-1-phosphate* (dipotassium salt), and *phosphoglyceric acid* (barium salt), three vitally important compounds in fermentation and enzyme reaction studies, are now available from Schwarz Laboratories, Inc. Also immediately supplied: *Schwarz* brand of fructose diphosphates (calcium, magnesium, and barium salts), purity 85 per cent minimum.

Schwarz fine chemicals satisfy the exacting requirements of products intended for use in biochemical or clinical research.

Write for revised price list

Schwarz **LABORATORIES, INC.**
204 East 44th Street
New York 17, N. Y.

Fully Automatic Radioassays



ONLY Tracerlab makes a completely automatic radioassay system.

TRACERLAB MAKES OUTSTANDING END-WINDOW GEIGER TUBES

Tracerlab's Automatic Sample Changer allows laboratories making radioassays on a large number of samples to obtain data faster, more accurately, and with greater reproducibility. *Fully automatic* radioactivity measurements on as many as twenty-five samples can be made on this versatile unit without the attention of a technician. Results in terms of elapsed time are printed on a tape by the Tracergraph, which also prints a corresponding sample index number.

In addition, half life measurements on short half life materials can be made, or, with the E-25 Automatic Absorber Attachment, energy spectrum data on a particular sample can be obtained with the unit automatically inserting absorbers of varying thickness over a fixed sample.

The complete unit for an automatic counting system consists of the Automatic Sample Changer, Shielded Manual Sample Changer (shown in position), Tracergraph Printing Interval Timer, and either the Autoscaler or Superscaler.

Complete information on these instruments is contained in Tracerlab's new 108-page Catalog. A copy will be sent on request.

Tracerlab

130 HIGH ST., BOSTON, MASS.

BERKELEY, CAL. — WASHINGTON, D. C.

NEW YORK, N. Y. — CHICAGO, ILL.

Science Teachers Report

A GREAT TIME SAVER IN TEACHING

THE AO SPENCER SCHOLAR'S MICROSCOPE

HOW THE AO No. 78 SCHOLAR'S MICROSCOPE CUTS TEACHING TIME

1. Easy to learn to use.
2. Single focusing control—fast and precise.
3. Factory-focused built-in light source eliminates time consuming and frequently faulty substage adjustments.
4. Reversed arm position gives clearer view of specimen stage, objectives, and diaphragm openings.

Since we are currently supplying both military and civilian needs, instrument deliveries cannot always be immediate.

• The reports keep coming in—yes, the AO Scholar's Microscope *does* save time in teaching students microscopy.

This radically new idea in microscopes has proven a boon to science teachers. The built-in light source assures permanently aligned illumination and consequently better optical performance with much less adjustment. Low overall height increases comfort in operation. Locked-in parts reduce maintenance costs. 'Spring-loaded' focusing mechanism protects slides against damage. See your AO distributor or write Dept. D2.

American Optical COMPANY

INSTRUMENT DIVISION • BUFFALO 15, NEW YORK